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Manual Endourology

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With 135 Figures

Springer

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Preface

With the first cystoscopy performed by Maximilian Nitze more than 100 years ago, endoscopy developed step by step to become eventually a subspecialty in urology now called endourology.

Manual Endourology addresses young trainees in urology and is written by experts in this field who are also experienced teachers. It is hoped that the book will be helpful to prepare the trainee in the first steps of these still fascinating techniques but will also prevent the newcomer from mistakes and common complications.

In 12 chapters, he or she will find the typical procedures, which are also the gold standard and therefore performed in almost every urological department. The text is written from all the authors in Simplified Basic English in order to facilitate the study in countries where English is the scientific but not the native language.

The pictures presented are a careful selection of several thousand photos. Of the highest possible quality, the majority of them are self-explanatory. The same is true for the video clips found on the DVD.

The structure of the text in each chapter is the same. It starts with Indications, Limits, Risks and Contraindications and proceeds to the Step by Step procedure. Common Complications are mentioned and Do's and Dont's as well as special comments from the author.

At the beginning, the trainee will observe his instructor who performs the operation step by step and will follow the operation on the screen. Later on he or she will gain experience using a simulator program and eventually will perform the first operations under the supervision of the teacher.

Well prepared for the first steps in endourology, we wish to encourage the trainee to ask his supervisor the right questions and thus start the process of interaction or »How to teach the teacher to teach.«

We also wish to encourage the trainee to establish a personal computer checklist to document all operations step by step in detail in a personal data bank. Completed by the complications encountered, the steps to be corrected to avoid complications can be delineated.

However, remember when starting the first endourologic procedures alone, stop immediately if there is the slightest resistance regarding which instrument to use. Any disproportion of your instrument may cause urosepsis or a lifelong obstruction.

We wish to thank here all the unnamed co-workers of the different institutions without whom this book could never have been published. The same is true for the companies, which assisted in producing the pictures and videos.

Furthermore we wish to thank the Deutsche Gesellschaft für Urology for the support of the training program initiated by GESRU (German Society of Residents in Urology).

Last but not least Dr. Rüttinger from Springer for his understanding helps, advise and coordination is given our warmest appreciation.

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Jens-Uwe Stolzenburg
Mainz, Leipzig
July 2005

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Endourological Training Models

Maurice-Stephan Michel, Herbert Leyh

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1

Introduction

Endourology is one of the most difficult techniques to learn. Safe and effective performance of diagnostic and therapeutic endourological procedures requires long-term practical experience. Training opportunities for urologists are diminishing due to reductions in the length of surgical training, appreciation of the true costs of operating room time and the pressures of long waiting lists. Furthermore, rapid developments in the endourological field, as an expanding knowledge base and emerging new techniques require continuing urological education to achieve lifelong learning and to keep the urologists up to date. Consequently, specific training is necessary to guarantee qualification of urologists. Several training modalities have been introduced for endourological training. Available training models include animal models as well as human or animal cadaver organs, synthetic organ models or computer-based simulation systems. Historically, the first endoscopic training models were cadaver models [1–4]. Particular interest has focused on using this model primarily for prostatic resection and secondarily for ureterorenoscopy [5, 6]. The performance of the procedures is similar to the clinical situation, but they are restricted by the lack of bleeding and haptic force feedback. Unfortunately, most of the synthetic organ models of the intrarenal collecting system have been inappropriate for training, and therefore the level of trainee interaction has been negligible.

In the past, several attempts have been made to overcome these problems [7]. In 1999, the first realistic computer-generated interactive simulator for transurethral prostatic resection was produced by Ballaro et al. [8]. However, this simulator was restricted to the resection of the prostate. Furthermore, the simulator lacks real-time interactivity as well as tactile feedback. In 2002, a new and improved computer-based simulation system came out with the goal of achieving a close resemblance to diagnostic and therapeutic rigid and flexible ureterorenoscopy in humans [9].

Comparing the different training models, it can be concluded that there is no all-round model that can be considered the best. Every different model has its specific advantages and disadvantages.

Synthetic Organ Models

Currently, the most frequently used models are the synthetic organ models for ureterorenoscopy (Fig. 1.1) and transurethral resection of the prostate (Fig. 1.2). These models are useful for residents in their early training, because they are able to use irrigation as well as standard instruments and tools while doing the first endourological steps. If fluoroscopic control is asked, the phantom model can be placed on an X-ray table. However, they are restricted by the lack of bleeding and the unrealistic force feedback. They are not useful for flexible ureterorenoscopy since they have no intrarenal collecting system.

Models like these can be bought by the urological department from different companies that produce these models for all disciplines in medicine. An alternative is to ask a company that produces endoscope or accessory instruments

Fig. 1.1. Synthetic organ model for ureterorenoscopy

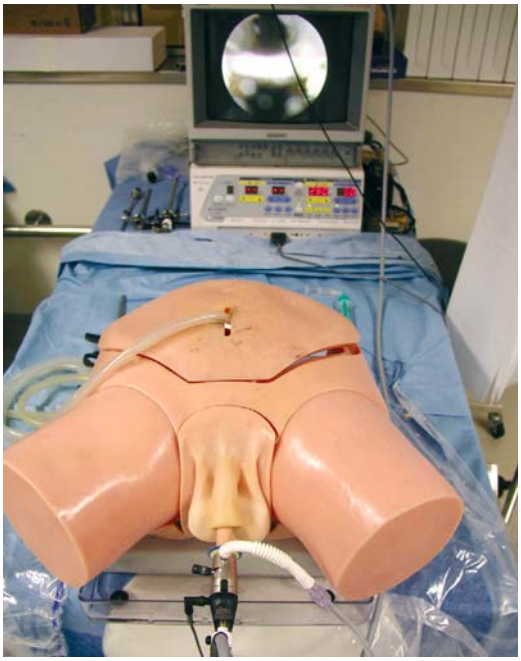

Fig. 1.2. Synthetic organ model for transurethral resection of the prostate

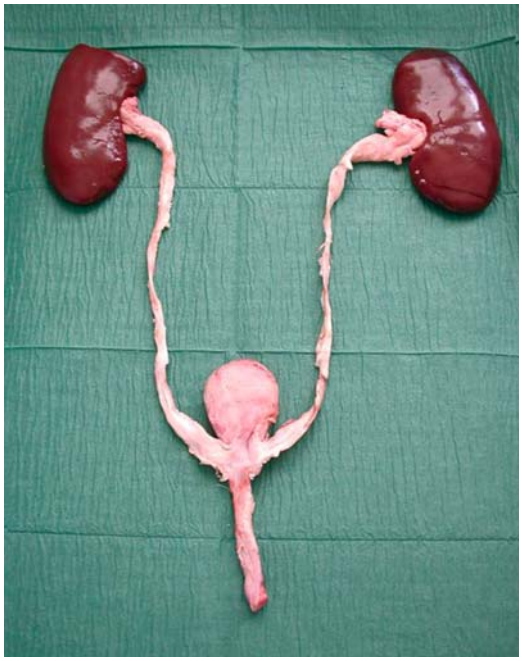

Fig. 1.3. Cadaver organ model for ureterorenoscopy

(i.e. wires and baskets) to obtain such a training model for 1 or 2 days in the trainee hospital. Senior staff members of the hospital can then train their own residents. If this is not possible or external international experts are wanted, hands-on training courses with phantom models are available at some national and international urological conferences (i.e. the annual meeting of the European Association of Urology).

Animal Organ Models

For advanced residents in training and urologists who want to be kept up to date on the latest technology such as holmium laser stone disintegration and flexible ureterorenoscopy, cadaver organ models can be used (Fig. 1.3). As with the synthetic organ model irrigation, standard instruments and tools can be used. If fluoroscopic control is requested, the tissue model can be placed on an X-ray table. Compared to the synthetic organ models, the advantages of these models are the relative realistic haptic force feedback and the precise anatomy of the intrarenal collective system. However, there is no simulation of bleeding possible.

Complete pig urinary tracts are most useful and can be bought directly at the slaughterhouse or at a butcher's. Local and national legislation in terms of using animal organs in the hospital and using instruments in animal urinary tracts and then in humans must be considered. Animal urinary tracts are also available at some hands-on ureterorenoscopy courses at national and international urological conferences (i.e. the annual meeting of the German Society of Urology).

Computer-Based Training Systems

The Uromentor system is the most frequently used computer-based training system for the

Fig. 1.4. Uromentor System for ureterorenoscopy

upper urinary tract (Fig. 1.4). Based on real patients, virtual cases are created (Fig. 1.5), and simulated as in a computer game (Fig. 1.6). Nearly every treatment tool as well as simulated X-ray control can be used (Fig. 1.7). At the end of each treatment procedure, the candidate gets a trainee file with a performance description (Fig. 1.8). The anatomy is close to the clinical situation. Even though bleeding can be simulated, realistic haptic force feedback and perforation is not possible. Furthermore, normal instruments can not be used, the included dummy instruments do not truly imitate the manual handling of endoscopes. More than 50 Uromentor systems have been sold worldwide to different urological departments. Most of them are used for student and resident training, but a high number of them also used for national or international training courses. The latest generation of the Uromentor includes the possibility to train the placement of a percutaneous

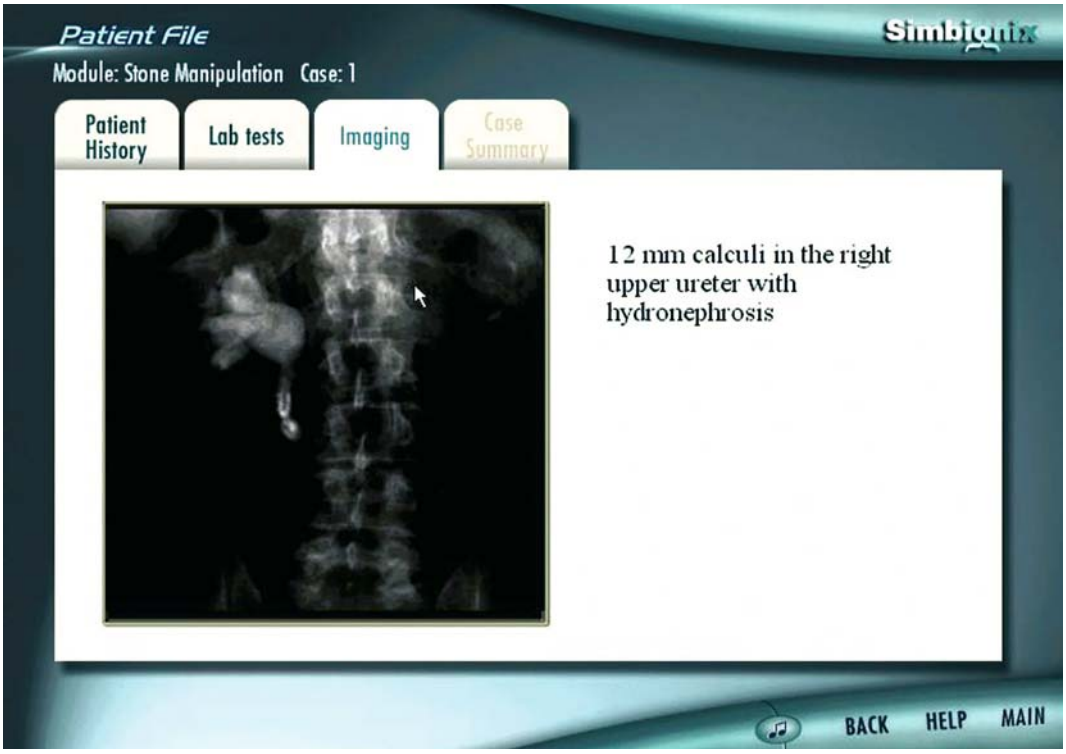

Fig. 1.5. Virtual endourological cases based on real clinical cases

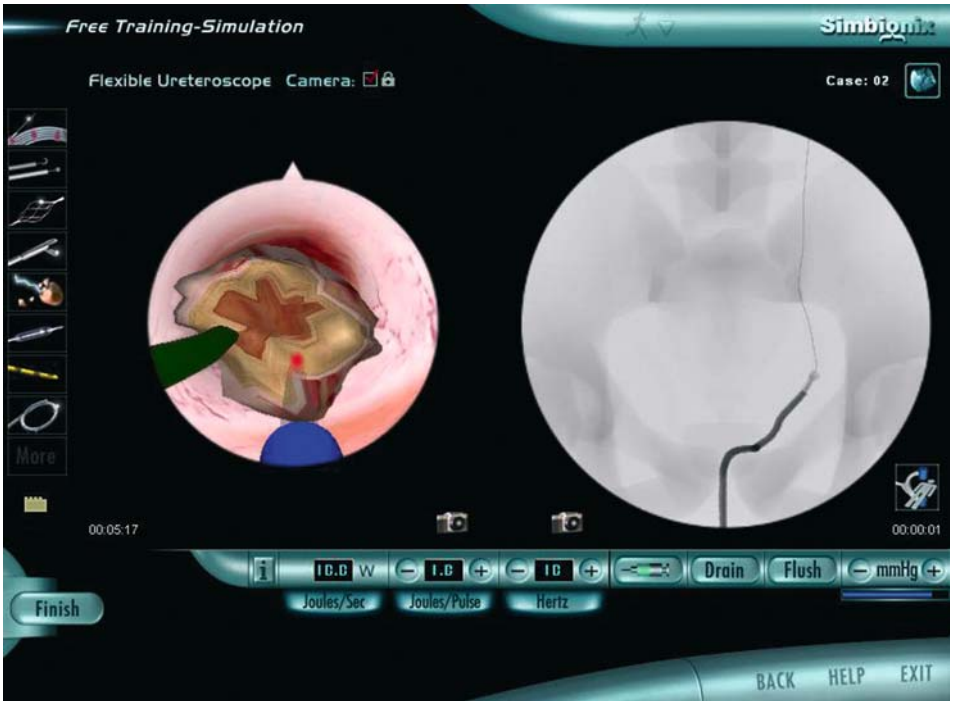

Fig. 1.6. Real time interactive simulated procedures

Fig. 1.7. Different treatment tools and X-ray can be selected

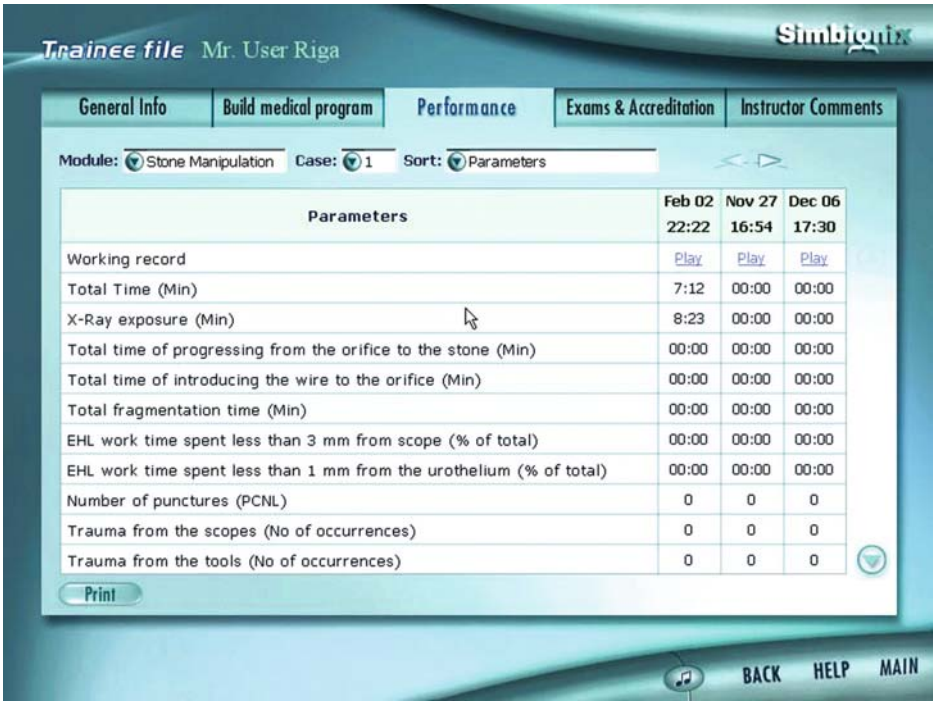

Fig. 1.8. Trainee file with performance description

Fig. 1.9. Uromentor system for placement of a percutaneous nephrostomy

nephrostomy (Fig. 1.9). Another computer-based training system has come out for the simulation of transurethral resection of bladder tumours. This system cannot yet be purchased. A prototype has been tested.

Tips for Training

- For student training with one of the above-described training models, first a clinical situation has to be created and a working diagnosis has to be defined.
- In the next step, you should check the instruments and learn to handle them before you start the treatment.
- Perform your treatment stepwise as is explained in the individual chapters of this book.
- Repetition and supervision by an experienced colleague is a very important factor.
- You will definitely notice the improvement of your skills after every training session.

- If you wish to introduce advanced endourological techniques in your department, visit a centre of excellence in this specific field and attend a number of procedures there.
- Perform training in this technique using one of the above-mentioned training models that best fits the technique.
- Ask somebody who is experienced in this technique to assist you in the first cases in which you perform the advanced new technique.

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Urethrotomy

Herbert Leyh, Roger Paul

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Introduction

Is the urethrotomy procedure still up to date?

Since open urethroplasty for treatment of urethral strictures has the highest and longest-lasting success rate, the question of why we still perform a large number of internal urethrotomies arises. What are the advantages of the endourological incision?

Urethrotomy

- is a simple procedure,
- it can be performed even under local anesthesia,
- it can be performed as an outpatient procedure,
- in most cases open surgery would be an overtreatment.

Therefore, internal urethrotomy performed for proper indications also has a role in the future in the treatment of urethral strictures.

Pathogenesis of Urethral Strictures

Strictures used to stem predominantly from infectious disease (sexually transmitted diseases, tuberculosis); today most of the strictures are post-traumatic or iatrogenic. External trauma is caused by injuries such as a fracture of the pelvis. Internal traumatic lesions, mostly of the bulbar urethra, are attributable to endoscopic instruments and urethral catheters. Pathogenic factors include mucosal lesion, inflammation, and locally reduced perfusion. The pathogenesis of urethral strictures after catheter stems from retention of secretion with bacterial invasion along the catheter and decubital necrosis of the mucosa, which will lead to periurethral inflammatory infiltrates and subsequent stenosis.

Preoperative Preparation

- Check the indication for urethrotomy.
- Check the diagnostic tools (uroflowmetry, urethrocystography, urethroscopy, penile ultrasound).
- Check the urine to exclude urinary tract infection. Provide perioperative antibiotic prophylaxis.

Anaesthesia

Usually the treatment will be performed under spinal or general anaesthesia. However, local anaesthesia is also feasible for short strictures.

Indications

Urethral strictures have long been managed by choosing the simplest treatment first, and only if this was not successful was a more complex or more difficult procedure chosen. Internal urethrotomy or repeated attempts at urethrotomy were performed, before an open surgical procedure was considered. However, long-term functional and cosmetic results rather than the simplicity of the procedure should govern the choice of therapy.

- Internal urethrotomy has a place in the treatment of strictures. It can be curative for strictures involving epithelium alone or those involving superficial spongiofibrosis (Fig. 2.1A–C).
- The indication for endoscopic treatment depends on the position and length of the stricture. The best results are obtained with urethrotomy for meatal stenosis and for simple and short bulbar urethral strictures.

Otis Urethrotomy

The »blind« internal urethrotomy using the Otis instrument is indicated for stenosis at the external urethral meatus and at the distal part of the

pars pendulans urethrae. Especially at the beginning of a TUR, this method is often indicated to avoid traumatic injury of the meatus urethra and the distal penile urethra.

Vision-Guided Internal Urethrotomy

This type of surgery is indicated for more proximal strictures, especially in the bulbar urethra.

Limitations and Risks

Specific risks of urethrotomy are acute bleeding and lesions to the external urethral sphincter.

Contraindications

Absolute contraindications are a purulent urethritis as well as a urethral abscess.

Instruments

Two different types of instruments for cold incision of urethral strictures are used:

- Otis urethrotome (Fig. 2.2).
- Sachse operating urethroscope (Fig. 2.3).

This viewing urethrotome does not significantly differ from a resectoscope and consists of a

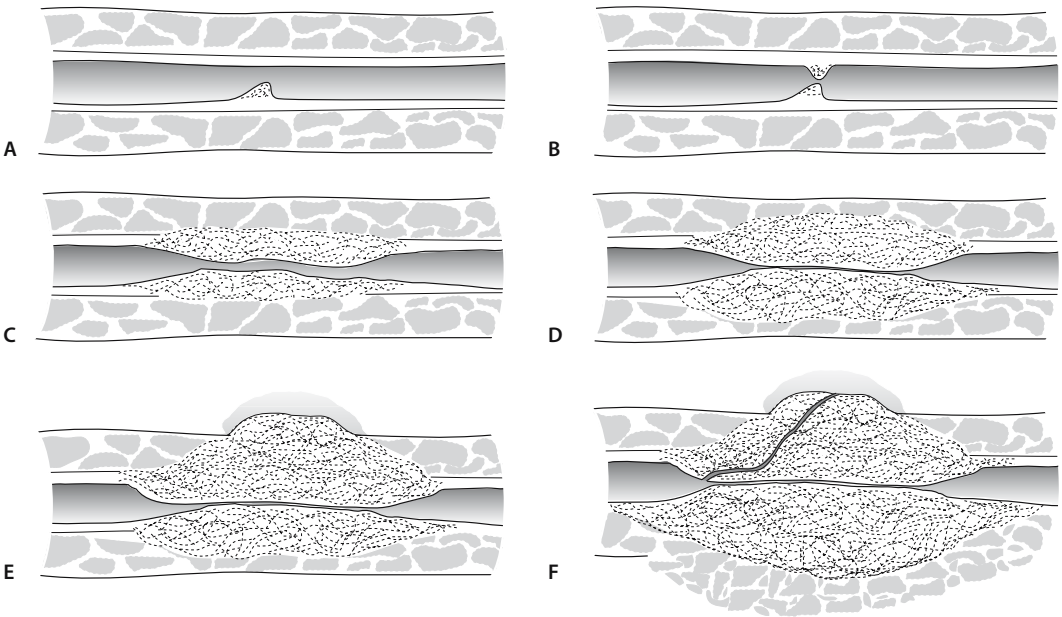

Fig. 2.1. Formation of strictures. **A** Mucosal fold. **B** Iris constriction. **C** Full-thickness involvement with minimal inflammation in the spongy tissue. **D** Full-thickness spongiofibrosis. **E** Inflammation and fibrosis involving tissues outside the corpus spongiosum. **F** Complex stricture complicated by a fistula

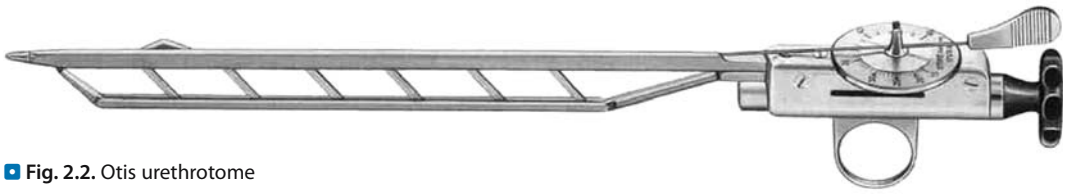

Fig. 2.2. Otis urethrotome

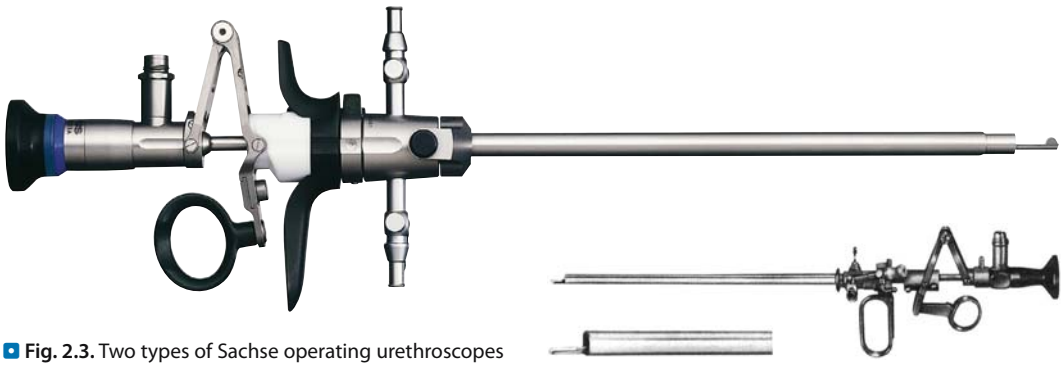

Fig. 2.3. Two types of Sachse operating urethroscopes

20-Fr urethrotome sheath and obturator as well as an operating element, which bears the knife and also has a channel for the passage of sounds. A 0° telescope is generally used.

Operative Technique (Step by Step)

- The patient is placed in the lithotomy position.
- After genital disinfection, sterile drapes are placed in the usual fashion as for any transurethral procedure.
- The incision can be done blindly with an Otis urethrotome or under direct vision with a cold knife instrument.

Otis Urethrotomy

- Introduce the well-lubricated urethrotome with the knife hidden inside the instrument into the external meatus.
- Pass the instrument through the stricture and open it until it lies in close contact with the lumen.
- After opening the instrument to 25–28 Fr, make the cut by moving the roof-like knife from the resting position and pulling it back through the stenosis at the 12 o'clock position. Do not move the instrument itself.

Usually only one smooth cut has to be made. That leads to a better healing of the urethral mucosa and to a lower tendency for stricture recurrence. However, if it becomes necessary to deepen the cut, open the Otis urethrotome a few French units until it once again lies in firm contact with the urethral wall. Then make a further cut by re-advancing the knife in the proximal direction. The disadvantage of the method is the insufficient control because of lack of visual feedback. This can lead to iatrogenic injury of the urethra.

Vision-Guided Internal Urethrotomy

- Fill the urethra with a lubricant jelly.
- After calibrating the meatus, introduce the urethrotome into the distal urethra.
- Move the instrument under direct vision until the stenosis is visible (Fig. 2.4).
- In case of a very narrow stenosis, pass a ureteral catheter (3 Fr) through the stricture into the bladder to guide the blade and prevent protrusion of the urethrotome into tissues outside the corpus spongiosum.
- Advance the cold knife under vision into the stricture guided by this catheter.
- Depress the proximal end of the urethrotome and cut upwards at the 12 o'clock position through the stricture (Fig. 2.5).
- Make the cuts by extending the blade and moving the entire operating scope as a unit. The incision advances millimeter by millimeter towards the bladder as the scalpel blade is extended out of the sheath and brought into contact with the stricture itself.

- The aim is to achieve a lumen of 24–26 Fr in the region of the stricture.
- Ensure there is sufficient vision before continuing.
- Be careful not to injure the striated external sphincter when you are cutting at the proximal bulbar urethra.
- In case of a short stricture, one pass with the blade may be enough.

Fig. 2.4. Endoscopic view of a bulbar urethral stricture

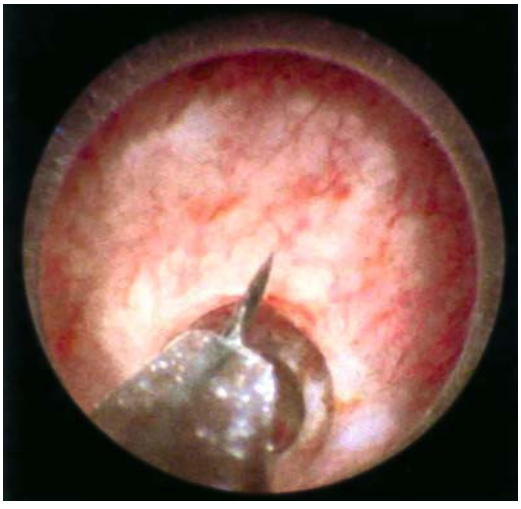

Fig. 2.5. Internal urethrotomy under vision with a cold knife

- With longer strictures with deeper fibrosis, the knife must be advanced through the narrow lumen until the normal urethra proximal to the stricture has been opened. The ureteral catheter will allow the blade to be advanced further and therefore the incision will be elongated.

Internal urethrotomy is helpful when the spongiofibrosis associated with the stricture is superficial and the incision extends through the depth of the scar. We prefer to make a single incision at the 12 o'clock position. Other surgeons prefer incisions at 10 and 2 o'clock or additionally at the 6 o'clock position. These multiple cuts must also be full-thickness incisions and not just superficial lacerations. However, with cutting at 12 o'clock one can better avoid injuries to the corpora cavernosa and to the cavernosal nerves and the risk of bleeding is minimized (Fig. 2.6). Also, cutting between 5 and 7 o'clock may lead to urethral diverticula or fistula formations.

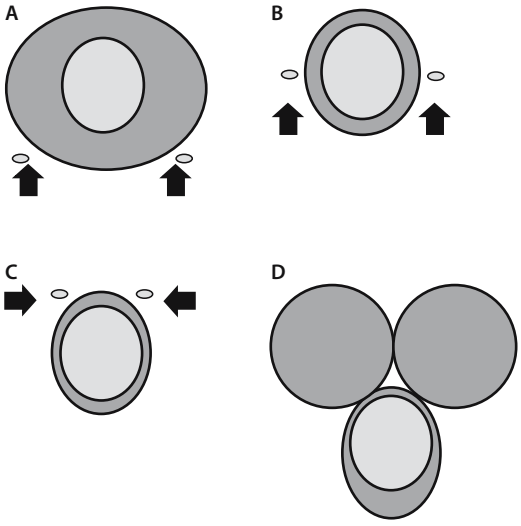

Fig. 2.6. Position of corpora cavernosa and cavernosal nerves to the urethra. **A** Distal prostatic urethra: cavernosal nerves at 5 and 7 o'clock. **B** Membranous urethra: cavernosal nerves at 3 and 9 o'clock. **C** Proximal bulbar urethra: cavernosal nerves at 1 and 11 o'clock. **D** Distal bulbar/penile urethra: cavernosal nerves inside the corpora cavernosa

Once the stricture has been opened wide enough to allow an easy passage of the urethrotome into the bladder, the same instrument should be used for a brief cystoscopy.

Afterwards, during removal of the instrument, perform a further urethroscopy with special care to the region operated on. If the stricture was located near the sphincter, specifically check the sphincter using the hydraulic sphincter test. After incision of the urethra, a 20-Fr soft silicone catheter should be passed with ease. The duration of the catheter drainage depends on the character of the stricture. The cut is not healed until urethral epithelium has covered the incision.

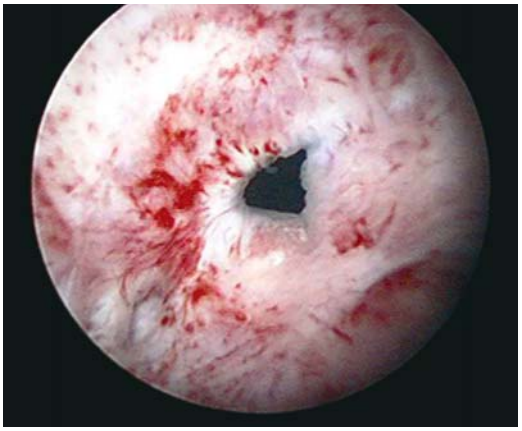

Fig. 2.7. Bladder neck stenosis

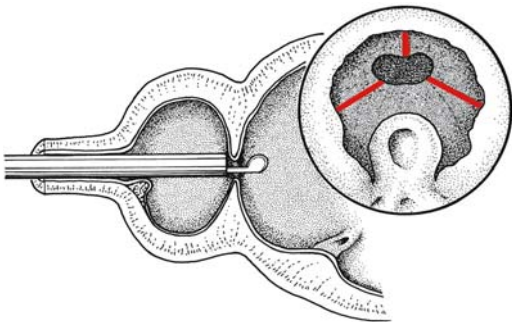

Fig. 2.8. Incision of bladder neck stenosis

Operative Tricks

In a nearly completely obstructed urethra with no chance to view or calibrate the proximal urethral lumen, it may be necessary to fill the bladder with methylene-blue dye by suprapubic puncture. With hand-assisted suprapubic pressure, the proximal lumen of the urethra can usually then be identified.

With a completely obstructed urethral lumen after a former traumatic injury, a »cut-to-the-light«- or a »rendez-vous«-maneuver will be necessary to find and open the way into the bladder. In these cases, a second surgeon shows the way for cutting by introducing a light source or a dilator into the prostatic urethra via a suprapubic access.

Internal urethrotomy under vision is also used for incision of symptomatic postoperative bladder neck stenosis. Usually three deep incisions at 4, 8 and 12 o'clock are made (Figs. 2.7, 2.8).

Postoperative Care

Postoperative care should follow these recommendations:

- Patients should be monitored for at least 3 h.
- Provide sufficient analgesic therapy.
- Monitor urine colour.
- The catheter can be removed after 1–2 days.
- Instill a lubricant jelly with cortisone for about 1 week.
- Monitor uroflowmetry and residual urine.
- Provide regular urological follow-up.

In some cases, a combination of urethrotomy and postoperative intermittent urethral calibration may improve the success rate.

Common Complications

Due to insufficient operative technique the following complications may occur:

- Bleeding.
- Infection.

- Extravasation of irrigation fluid or urine with consecutive infection.
- Penile or scrotal edema may occur but is usually reabsorbed within 1–2 days.
- Urethral perforation and via falsa.
- Urethral fistula.
- Urethral diverticulum.
- Injury to the corpora cavernosa.
- Injury to the striated external sphincter with subsequent incontinence.
- Erectile dysfunction by direct injury to cavernosal nerves, local infection or shunt formation between corpora cavernosa and corpus spongiosum.

Careful technique, irrigation with isotonic solution and strict observance of purulent urethritis or urethral abscess as a contraindication generally result in a low complication rate. Profuse hemorrhage is usually controlled by the passage of a 24-Fr catheter, occasionally in combination with a penile pressure dressing.

Laser Urethrotomy

Instead of the cold knife urethrotomy, a laser incision may also lead to similar results. Nd-YAG-, Argon- or KTP-laser are used. However, the results are still being debated. In any case, this method is interesting in treatment of complete obliteration of the urethra after pelvic fracture.

Outcome

The success rate of internal urethrotomy can be improved if the following conditions are considered:

- Number of strictures: 1.
- Extent of stricture: <1 cm.
- Localization of stricture: bulbar urethra.
- Urethral diameter at the stricture: >15 Fr.
- Initial manifestation of stenosis.
- Each urethrotomy produces new scars of different extension, which forms the base for recurrent strictures.

The recurrence rate after internal urethrotomy is up to 60%. About half of the recurrences develop during the first postoperative year. Since the third urethrotomy leads to a further recurrence of stenosis in nearly 100%, two attempts of urethrotomy should be the limit. If the obstructive symptoms recur rapidly, open surgical treatment should be considered.

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Urethrocystoscopy

Herbert Leyh, Roger Paul

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Introduction

Endoscopic examinations are one of the most important tasks in urological diagnostics and therapies. Especially the endoscopy of the urethra and the bladder are regarded as standard diagnostic procedures in urology. Since the development of the first *Kystoskop* by M. Nitze in 1879, which replaced the prior blind investigation of the bladder and revolutionized bladder diagnosis, the endoscopic orientation in the bladder for diagnosis and therapy was continuously improved by the introduction of cold light and the improvement of the optical system, videoendoscopy, flexible instruments and virtual endoscopy.

Indications for Urethrocystoscopy

- Gross hematuria.
- Persistent hematuria.
- Suspicion of bladder carcinoma, tumour infiltration from outside or metastases.
- Follow-up in superficial bladder cancer.
- For patients with upper tract transitional cell carcinoma to rule out coexistent bladder tumours.
- Inspection of orifices in vesicoureteral/renal reflux or ureterocele.
- Recurrent urinary tract infection (UTI).
- Diagnosis of interstitial cystitis.
- Suspicion of urogenital tuberculosis.
- Diagnosis of incontinence.
- Diagnosis of female urethral diverticula.
- Suspicion of vesicovaginal or vesicoenteric fistula.
- Neurogenic voiding dysfunction.
- Suspicion of subvesical obstruction (bladder outlet stenosis).
- Detection of urethral or vesical foreign bodies.
- Urethral inspection under suspicion of stricture, tumour, diverticulum or fistula.

Limitations and Risks

For patients with pyuria, appropriate specimens for cultures should be obtained to document sterility of the urinary tract prior to endoscopy. Cystoscopy during untreated UTI should be avoided, because of possible exacerbation of symptoms or sepsis. Endoscopy should be performed after specific antibiotic therapy. Acute and heavy bleeding may lead to insufficient endoscopic evaluation.

Contraindications

- Acute urethritis, acute prostatitis, acute epididymitis.
- Febrile urinary tract infection.
- Strong coagulopathy.

Instruments

Rigid and flexible instruments of different sizes are available for the endoscopic examination of the lower urinary tract to fit all indications mentioned.

Rigid Cystoscopes

The sheath diameter of a rigid cystoscope ranges from 6 to 24 Fr. In adults, most commonly instruments from 15 to 24 Fr are used. The size should be adapted to the indication. For a diagnostic cystoscopy, small endoscopes are fully sufficient; if additional working channels are needed a larger size should be chosen.

Rigid instruments consist of:

- The sheath.
  - Adapter for irrigation inflow and outflow.
  - Intermittent irrigation with sterile water, sodium chloride possible.
- Obturator.
  - For blind insertion of the instrument.

- Telescope.
  - With adapter for cold light.
  - 0–12° telescope for straight view.
  - 30° straight and lateral view.
  - 70–120° retrograde view.
- Optional working adapter.
  - Different adapters depending on the sheath size are available for introducing additional instruments, i.e. ureteral catheters, grasping or biopsy forceps.
  - An Albarran steering lever to navigate the working instruments between 0–30°, especially to intubate ureteral orifices (Fig. 3.1).

Advantages of rigid cystoscopy:

- Superior telescopes.
- Larger working channel for auxiliary equipment.
- Larger irrigation channel and therefore improved vision, improved evacuation of blood clots and detritus.
- Facilitated manipulation and easy orientation during inspection.

Flexible Instruments

Flexible instruments are available with a diameter of 16 Fr or less with bending of the instruments up to 210° upwards and 120° downwards, allowing inspection of the total bladder. (Figs. 3.2, 3.3)

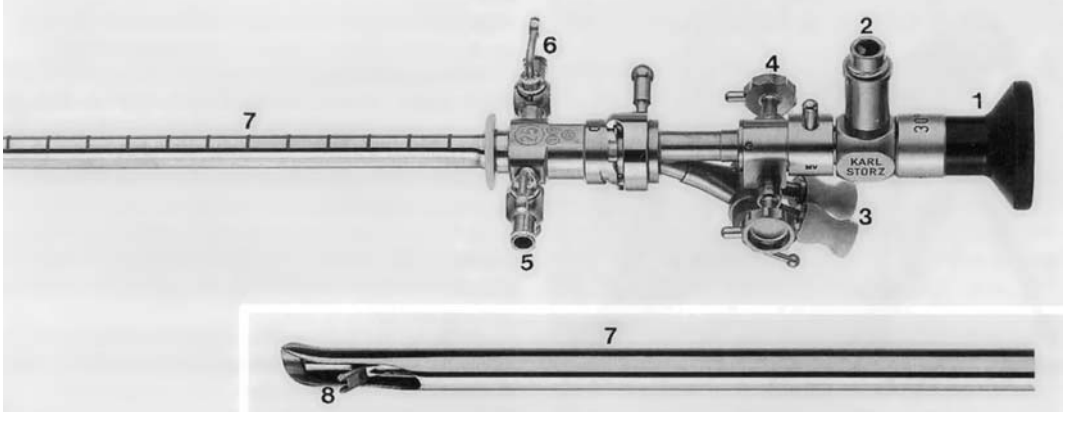

Fig. 3.1. Rigid cystoscope. *1* telescope; *2* adapter for cold light, *3* working adapter for introducing additional instruments, *4* Albarran steering lever, *5* adapter for irrigation inflow, *6* adapter for irrigation outflow, *7* sheath, *8* Albarran

Fig. 3.2. Flexible urethrocystoscope

Fig. 3.3. Navigation of the flexible urethrocystoscope

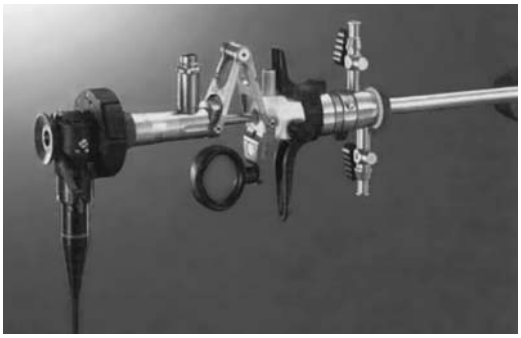

Fig. 3.4. Videoendoscopy

The working channel allows the use of flexible instruments (i.e. catheter, flexible forceps, coagulation probes) up to 6 Fr.

Advantages of flexible cystoscopy:

- Convenient for patient, nearly pain free, well tolerated.
- Total inspection of bladder with one optical instrument.
- Special indication in continent urinary diversion (i.e. ileal neobladder).
- Special indication of endoscopy of ileal conduit.
- Special indication for patients who cannot be positioned for rigid endoscopy due to contractures of the lower extremities or cox arthrosis.
- Special indication for patients with frozen pelvis.

Videoendoscopy

Today videoendoscopy is a routine procedure in most urological departments (Fig. 3.4).

Advantages of videoendoscopy (flexible and rigid endoscopy):

- Physiological posture of examiner.
- Binocular view.
- Improved detailed diagnosis.
- Improved teaching possibilities.
- Advantage for patients with limited positioning (i.e. cox arthrosis).
- Less risk for contamination to the examiner.

Preoperative Preparation

The genital area should be prepared and disinfected. Antimicrobial prophylaxis is mandatory in patients with prosthetic valves or valvular heart disease with risk of endocarditis or for patients with special infectious risks.

Anaesthesia

Generally well tolerated with local anaesthesia in adults, in women usually no anaesthesia at all is required. In children and in some cases, however, general anaesthesia is necessary, e.g. individuals with symptoms suggestive of interstitial cystitis, including those with only severe frequency and urgency who have sterile, microscopically clear urine, should undergo cystoscopy under anaesthesia to diagnose or rule out this disease.

Operative Technique (Step by Step)

Positioning varies according to the instrument used:

- Rigid cystoscopy: lithotomy position.
- Flexible cystoscopy: supine or lithotomy position.

Preparation includes:

- Every endoscopy should be performed under sterile conditions.

- Cleaning and disinfection of the penis, especially the glans penis.
- Local anaesthesia in men:
  - Instillation of 8 ml of lubricating gel with local anaesthetic. Penile clamp prevents backflow of gel.
  - Waiting time of a few minutes.

Rigid Cystoscopy

Inserting the instrument:

- Calibrate external urethral meatus.
- Introduce the cystoscope blindly or under direct vision.
- Procedure should be pain free.
- Never use pressure or force.
- Gently introduce the sheath without mucosal injury to avoid possible urethral strictures.
- Blind introduction in men:
  - Straighten the penis.
  - Use excessive lubricating gel.
  - Introduce the sheath, closed with the obturator.
  - In the bulbar part, the urethra turns from an almost horizontal direction to a steep rise behind the symphysis towards the bladder neck. The curvature at the bulb is easily to overcome by lowering the instrument.
  - Curvature due to a large endovesical median lobe: this change in direction must be compensated for by lowering the eyepiece of the instrument, a possibly painful procedure in patients without anaesthesia.
- Introduction under direct vision in men:
  - Straighten the penis.
  - Use excessive lubricating gel.
  - Introduce the sheath over the external meatus closed with the obturator.
  - Remove the obturator and use the 0° telescope.
  - With continuous flow irrigation and straightened urethra, gently move towards the bladder.

Endoscopy

Performing a cystoscopy in men should always include inspection of the urethra. Always perform a systematic urethrocystoscopy to rule out underdiagnosis.

A report should be written at the end of every cystoscopy, if possible with schematic drawings or video documentation of pathologic findings.

In urethroscopy:

- Inspect all parts of the urethra (penile, bulbar, membranous and prostatic).
- Assess luminal size (strictures, diverticula, fistulas)
- Evaluate mucosa (lesions, tumours).
- External striated sphincter (pass with gentle pressure).
- Prostatic urethra.
  - Verumontanum.
  - Side lobes.
  - Estimate length of prostatic urethra.
  - Inspect the bladder neck opening.

In cystoscopy:

- Start inspection with the 30° telescope, supplement with different telescopes (i.e. 70°) if necessary to inspect all areas of the bladder (i.e. roof, bladder neck).
- Start with inspection of the trigone (position, form, numbers of ureteral orifices, colour of urine jet).
- Systematic evaluation of the base, lateral walls, posterior wall and roof of the bladder and bladder outlet.
  - Start at the base of bladder from left to right or vice versa.
  - By turning the instrument, inspect the roof of the bladder; sometimes it is necessary to push the bladder with your free hand from the abdominal wall towards your instrument.
  - In case of enlarged median lobe of the prostate, use a 70° telescope to inspect the trigone and ureteral orifices.
- Use inflow and outflow of irrigation fluid as necessary.

- If vision is impaired (i.e. pus, blood), excessive irrigation of bladder may be necessary before inspection.
- Look for:
  - Ureteral orifices (position and form).
  - Tumours.
  - Trabecula.
  - Lesions of the mucosa.
  - Diverticula and fistulas.
  - Stones and foreign bodies.

  Additional investigations:
- Consider additional investigations as indicated:
  - Bladder washing.
  - Vaginal and/or rectal palpation.
  - Vaginal inspection.
  - Stress test and Marshall-Marchetti test.

  Normal findings:
- Healthy bladder mucosa appears yellow to pink with small vascular branches.
- Ureteral orifices.
  - Positioned within the trigonal rim.
  - Slit-like or a flat indentation.
  - Refluxive orifices are commonly lateralized and/or horseshoe-like in shape.

Flexible Cystoscopy

The patient should empty the bladder prior to performing a flexible cystoscopy. Preparation and local anaesthesia are performed as described above with the exception of the lithotomy position, which is not mandatory. Flat supine position in male patients is possible.

Insertion of the instrument:

- Use excessive lubricating gel.
- Straighten the penis with the middle and ring finger of one hand and hold the tip of the cystoscope with the thumb and index finger to guide the instrument into the external meatus.
- Slowly pass the instrument through the urethra with continuous flow irrigation.
- By bending the tip of the instrument, it is possible to overcome even large prostatic median lobes with the roughly 35-cm-long instrument.

In cystoscopy:

- A systematic and complete inspection of the bladder is mandatory as described above.
- By bending the instrument more than 180°, it is possible to retrograde inspect the bladder neck.
- Consider repeating the cystoscopy if the vision is impaired due to detritus, blood clots or active bleeding.

Urethrocystoscopy of Female Patients

- The shortness of the female urethra allows pain-free investigation with rigid endoscopes.
- Cystoscopy should be performed together with calibration of the urethra using a bougie-à-boule probe if indicated.
- Blind insertion with the closed instrument (sheath and obturator) is possible.
- Inspection of the bladder as in the male cystoscopy.
- Inspection of the urethra to rule out urethral tumours, diverticula and fistulas is more difficult due to the shortness of the organ.

Figures 3.5–3.12 show various findings on urethrocystoscopy out of hundreds of possible endoscopic views.

Fig. 3.5. Urethral calculus

Fig. 3.6. Urethral calculus with via falsa

Fig. 3.7. Extraction of a urethral calculus

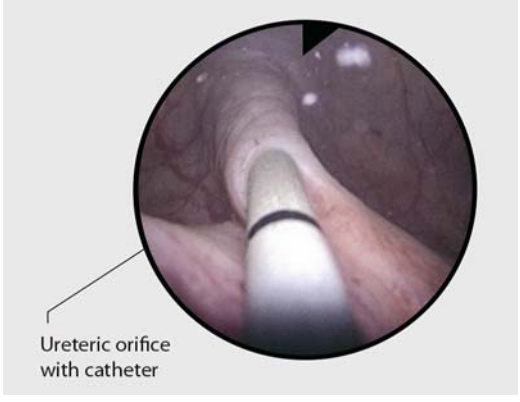

Fig. 3.8. Ureteric orifice with catheter

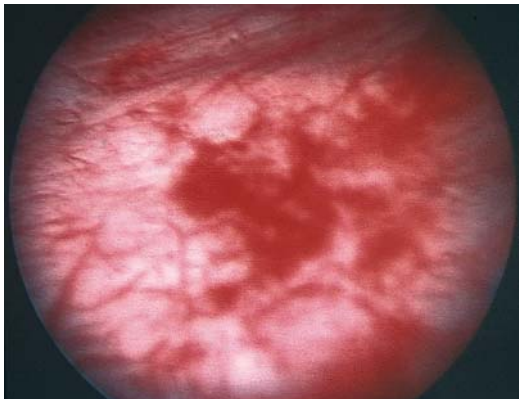

Fig. 3.9. Radiation-induced cystitis

Fig. 3.10. Suture after incontinence surgery

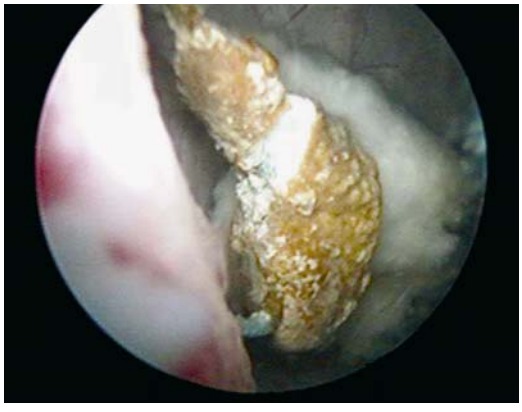

Fig. 3.11. Suture and incrustation after incontinence surgery

Fig. 3.12. Endoscopic view from the distal part of an ileoureteral substitute

Fig. 3.13. False passage urethra

Operative Tricks

- Dynamic cystoscopy: examination of the bladder under variable filling may also be helpful to inspect all areas.
- Chromocystoscopy

Ureteral orifices not identifiable; use indigo-carmine-blue dye intravenously.

- 5-Aminolevulinic acid-induced fluorescence cystoscopy for the detection of lower urinary tract tumours.

Postoperative Care

Recommend increased fluid intake for 24 h.

Common Complications

- Occasionally pain because of mucosal lesions, dysuria.
- Rarely bleeding or transient gross hematuria.
- Very occasionally traumatic lesion of the urethra with perforation.
- very rarely perforation of the bladder, possible in pronounced bladder tumours and impaired vision or contracted bladder.
- Uncommon traumatic urethral strictures due to mucosal lesions.

Mucosal urethral injury with consecutive bleeding may occur by passage of the urethra with an open Albarran steering lever.

Injuries distal to the External Sphincter

Below the external sphincter the instrument may find a false passage (via falsa) out of the bulbar urethra into the perineum. That will occur especially in blind insertion of the instrument (Fig. 3.13).

Subtrigonal Perforation

Perforations under the trigone are considerably more problematic, resulting from further advancement of the instrument after perforation of the median prostatic lobe in an attempt to enter the bladder. In such a case, the view will reveal not bladder mucosa but the web-like strands of fatty areolar and loose perivesical tissue. Complications can be avoided if the endoscopy is perfor-

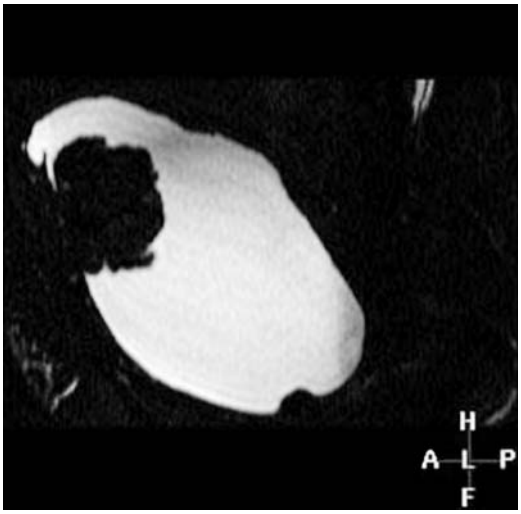

Fig. 3.14. NMR of a bladder tumour

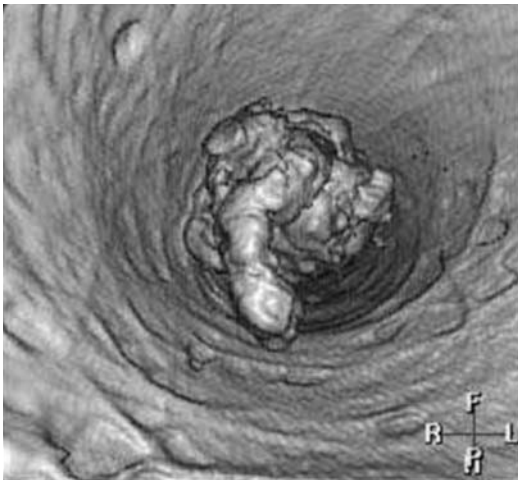

Fig. 3.15. Virtual cystoscopy of a bladder tumour

med in the correct technique as described, but always check the correct indication first.

New Developments: Virtual Cystoscopy

Virtual endoscopy of the lower urinary tract may replace invasive cystoscopy in future. Data from computed tomography (CT) or magnetic nuclear resonance tomography (NMR) are used to reconstruct a virtual, three-dimensional endoscopic view (Figs. 3.14, 3.15). New software developments allow the investigator to inspect the urinary tract by »flying« through the urethra and bladder. Complications of the invasive endoscopy could be eliminated. Recent problems of virtual endoscopy are to visualize small mucosal lesions, i.e. carcinoma in situ.

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Rare findings in Cystoscopy

Hassan Abol-Enein

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Introduction

The collection of pictures hereafter was obtained from the Urology and Nephrology Center at Mansoura University, Egypt. These pictures were collected during a period of 3 weeks only from the outpatient cystoscopy room as well as some from the inpatient endoscopy theater. These included some interesting findings in the urethra, bladder neck area and bladder cavity. Although it may be uncommon to observe such rare lesions during the routine practice in the industrialized part of the world, with globalization and increasing travel on the part of urologists working abroad and patients seeking treatment, such pathologies will be encountered. Many specific and nonspecific disorders merit knowing and reviewing the differential diagnosis. However, tissue biopsy is the key of diagnosis of any suspicious, unfamiliar pathology. I hope that these pictures might contribute to residents' and young urologists' knowledge of urology.

Image Gallery

Fig. 4.1. Severe form of nonspecific urethritis

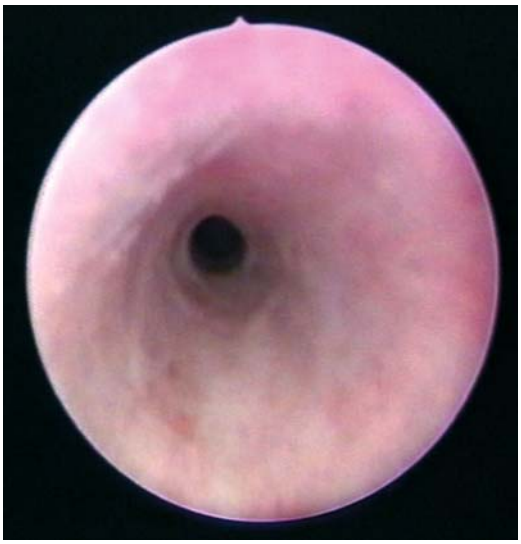

Fig. 4.2. Annular stricture of the bulbous urethra

Fig. 4.3. Postprostatectomy obstruction. Narrow membranous urethra where the verumontanum can be seen proximally

Fig. 4.4. Sever urethritis following TURP. Note the whitish areas in the prostatic fossa on both sides of the verumontanum. Culture showed fungus growth

Fig. 4.5. Acute urine retention following TURP, missed residual adenoma at the left lobe of the prostate

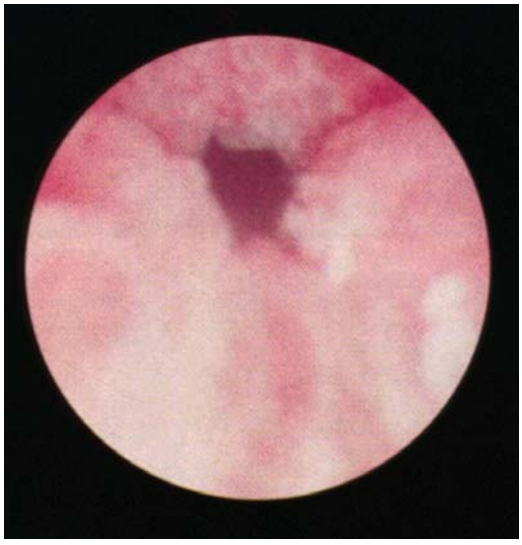

Fig. 4.6. Bladder neck in a bilharzial patient as seen from the urethral side by optic lens

Fig. 4.7. Acute cystitis with bladder trabeculation

Fig. 4.8. Bilharzial bladder showing extensive thick plaque of squamous metaplasia and leukoplakia close to squamous cell carcinoma

Fig. 4.9. Large pedunculated bilharzial granulomatous polyp

Fig. 4.10. Multiple yellow brown peppery cysts (cystitis cystica)

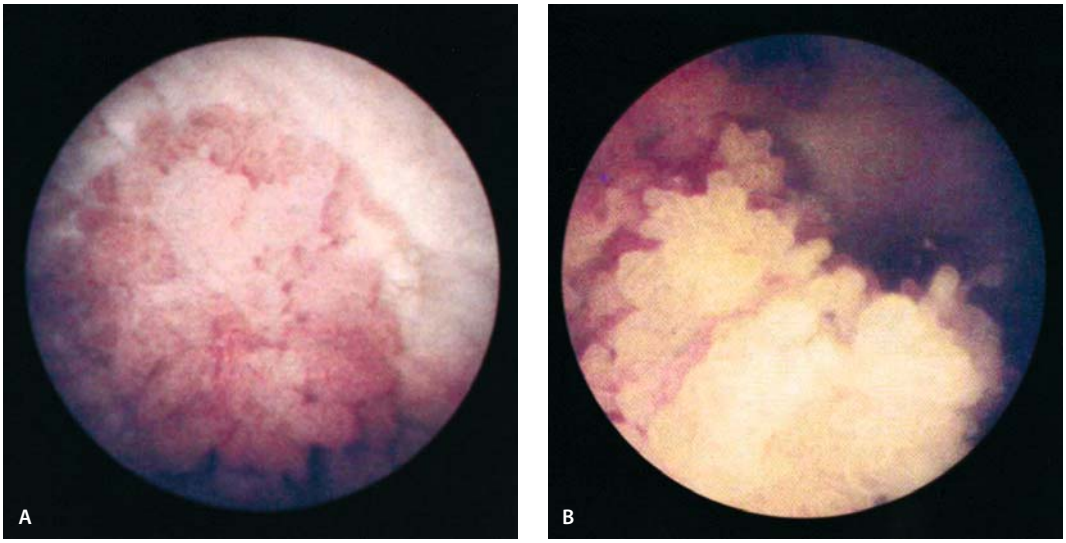

Fig. 4.11. A, B Papillary transitional cell carcinoma in a bilharzial bladder

Fig. 4.12. Bilharzial bladder showing evidence of healing ulcer (*left*) cystitis cystica (*right*) Anemic patches and hyperemic areas

Fig. 4.13. Evolution of bladder tumour in a bilharzial bladder, metaplasia, leukoplakia, with the fleshy tumour above

Fig. 4.14. Bilharzial nodule just medial to the slit of the left ureteric orifice

Fig. 4.15. Adenocarcinoma located just above the bladder neck at the trigone area during biopsy

Fig. 4.16. Mixture of acute and chronic ulcers in a heavily infected bilharzial bladder

Fig. 4.17. Bladder tumour showing filamentous with growth of keratinized tissues (verrucous squamous carcinoma) (GISCC)

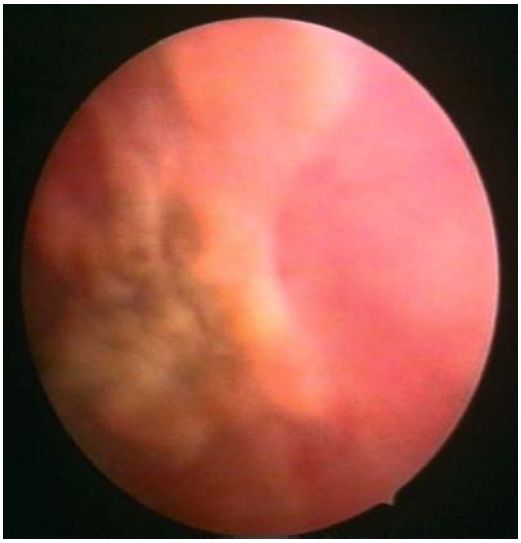

Fig. 4.18. Residual tumour after radiotherapy with evidence of radiation cystitis (hemorrhagic cystitis)

Fig. 4.19. Bladder with history of large perforation showing an epithelized false diverticulum

Fig. 4.20. Tumour exiting a diverticulum

Fig. 4.21. Bladder of a paraplegic patient with indwelling catheter showing encrustation, diverticulum and areas of ulceration

Pediatric Endoscopy

Marcus Riccabona, Ulrike Necknig

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Introduction

The spectrum of pediatric endourology, i.e. the diagnostic and therapeutic procedures, has changed in recent years and has expanded in many fields as the technology and armamentarium have evolved. Advanced optical systems enable videoendoscopy already in the newborn and in addition new endoscopic treatment alternatives have gained widespread acceptance. All endourological procedures, even urethrocystoscopy, are invasive during infancy and childhood and are usually performed under general anaesthesia. Therefore any endoscopy in the child has to be questioned for its need and possible therapeutic consequences.

Urethrocystoscopy

Diagnostic Indications

- Congenital anomalies (bladder diverticulum, ureterocele, urachal remnants, müllerian duct remnants, utriculus cyst, posterior valve, syringocele, urethral stricture, urethral duplication, etc.),
- Suspicious infravesical obstruction,
- Recurrent urinary tract infection (UTI) after VCUG and urodynamic investigation (but not routinely),
- Haematuria,
- Persistent incontinence (ureteral ectopy),
- Sinus urogenitalis, disorders of sexual differentiation,
- Follow-up after defunctionalization of the bladder (urinary diversion, Mainz pouch II, etc.).

Therapeutic Indications

- Endoscopic treatment of:
  - Reflux,
  - Neurogenic bladder,
  - Ureterocele,
  - Posterior urethral valve,
  - Urethral stricture.

Contraindications

- Acute (febrile) UTI.
- Coagulopathy.

Patient Counseling and Consent

- Painful micturition after endoscopy, frequently.
- Urinary retention, very rarely.
- UTI, haematuria.

Instruments

The normal male neonatal urethra can usually accommodate an 8-Fr instrument. The narrowest point of the male urethra is the meatus. Gentle handling of any endoscopic instrument is essential. The urethral mucosa is very fragile in the child; any trauma should be prevented or mucosal injury may result in stricture formation.

Pediatric urethrocystoscopes ranges in size from 4.5–12 Fr (see detailed pediatric instruments ◘ Table 5.1).

Techniques (Step by Step)

- Supine lithotomy position.
- Warm the patient during the entire procedure (37°C).
- Clean the genital area.
- Remove the wet sheet.
- Inspect the genital area for any pathology.
- Calibrate the meatus if meatal stenosis is suspected.
- Take the endoscope and put on the light and fluid cord.
- Lubricate the instrument.
- Pass the instrument gently under direct vision and continuous flow.

Endoscopic Treatment

Reflux

Endoscopic injection of the bulking agent was pioneered in 1981 by Matouschek as an alternative to conservative medical treatment and surgical

Table 5.1. Pediatric cystourethroscopes

	Shaft (Fr) Tip/Proximal	Angle of view (degrees)	Length (cm)	Irrigating/working channels (Fr)
Olympus				
S-1234/1[a]	6.4/7.8	7°	13.0	4.2, straight
S-1234/2[a]	8.6/9.8	7°	14.0	6.6, straight
Storz				
27030K[a]	7.5/8.5	0°	11.0	2.4, 3.5, straight
27030K[a]	10.0/10.5	0°	11.0	5.5, straight
Wolf				
4615.401	4.5/6.0	0°	11.0	2.4
8616.411[a]	6.0/7.5	0°	14.0	4.0
8626.431[a]	9.5	5°	11.6	5.0, straight

[a] Autoclavable for sterilization.

reimplantaton. Endoscopic treatment was started with the subureteric injection of Teflon. Outstanding results have been reported, with an overall cure rate of 90%, although a number of children will require two or even three treatments (Puri 1995). Injection of Teflon paste has not been accepted in the United States where some studies have demonstrated migration of Teflon particles to other parts of the body. Consequently, a search has been on for other injectable agents. The viability of endoscopic injection has proven to be highly dependent on the selected injectable agent. Numerous materials have been tried. Teflon, silicone and cross-linked bovine collagen have been studied thoroughly. However, concerns regarding the safety and efficacy of these agents have precluded their widespread use.

The only agent that is currently approved by the American Food and Drug Administration for this purpose is Deflux. Dextranomer/hyaluronic acid copolymer is biodegradable and devoid of allergenic, immunogenic or mutagenic potential. Success rates with Deflux average about 70% per injection, even in expert hands. Morbidity is minimal, with the procedure being performed on an outpatient basis in most cases, and there is no need for a catheter, as dysuria is minimal and the child return to normal activity within 1 day.

One fascinating new concept and new treatment algorithm is that of immediate endoscopic treatment of reflux of any grade at any age. The philosophy behind this still experimental approach is that compared with antibiotic prophylaxis, immediately successful endoscopic repair with minimal morbidity provides a better cure rate; no risk of poor compliance or bacterial resistance; avoids annual VCUGs or radionuclide tests; and avoids the use of prophylactic antibiotics and therefore much anxiety and stress on the family, thus conforming to parental preference. Randomized clinical trials of immediate endoscopic treatment vs traditional management are under investigation. Preliminary results demonstrate a 77% cure rate; the 23% who still have reflux are treated with prophylaxis and urotherapy, which should result in a 20% further reflux resolution rate. In the remaining 2%–5% of patients, open surgical correction is preferred.

Indications

- Primary reflux grade II, III and IV as an alternative to antibiotic prophylaxis.
- Grade I in bilateral reflux.
- Reflux persistence or recurrence after surgical treatment.
- First-line treatment of any reflux in the future?

Limited (no) Indications

- Primary grade V reflux.
- Lateralized golf-ball-sized orifice.
- Ectopic ureter.
- Reflux and ureterocele.
- Ureteral duplication.
- Chronic cystitis and dysfunctional voiding.
- Neurogenic bladder.
- Age under 1 year.

Endoscopic Injection Technique (Step by Step)

- Prepare the 8-Fr urethrocystoscope with straight working channel and 30° lens.
- Fill the bladder to half of age-related capacity.
- Insert the needle (3 or 5-Fr) in the 6 o'clock position under the mucosa of the orifice 2–3 mm proximal to the orifice and elevate the needle.
- Inject the bulking agent until a volcano-shaped and slit like orifice is obtained.
- Keep the needle in place 30 s. after the end of injection.
- No catheter drainage.

Tips and Tricks

- Do not fill the bladder too much before the procedure.
- Use a metal needle (3.7 Fr Cook) with two reference marks to guide proper placement during the procedure.
- Twist the needle during injection to the left and to the right.
- Instill a local anaesthetic lubricant into the urethra after the procedure to avoid painful micturition.

Sources of Failure

- Displacement of the material.
- Loss of the material volume.
- Dysfunctional voiding.

Smellie at al. had demonstrated that children with reflux but no renal scarring who where maintained infection-free did not suffer serious consequences as adults.

Consequently, there is a need for early recognition and treatment of children with reflux and UTI to limit scar development. Vesicoureteral reflux (VUR) is not a single pathological entity but a the result of a dynamic interaction between normal anatomy and function. Voiding dysfunction is now recognized to play an important role in the etiology of primary reflux. Antibiotics, endoscopic treatment and surgery are choices to manage reflux. It is important to explain and discuss the risks, benefits and follow-up of each treatment. Management should be individualized, is based on specific indications and parental preference. Many families still start with antibiotic prophylaxis to await the spontaneous resolution of reflux and to avoid anesthesia and surgery. Surgery may be favoured if VUR is severe, if there are other related medical conditions or if the highest success rate is the most important factor in family's personal view. In several pediatric urology centers, endoscopic treatment is being considered as the first option to treat reflux. The durability and the incidence of UTI and scarring after endoscopic treatment remain unanswered.

Neurogenic Bladder

Clean intermittent catheterization (CIC) as well as the administration of anticholinergic medication should be started early in treatment of myelomeningocele children with detrusor hyperreflexia in order to partially block the afferent parasympathetic innervation of the detrusor and to ensure a regular and complete emptying of the bladder. About 10% of patients are nonresponders to anticholinergic medica-

tion, and some suffer side effects from anticholinergic drugs, even if administrated intravesically.

Indications

Persisting leak-point-pressure over 40 cm H_2O after oral anticholinergic medication oxybutynin chloride (Ditropan) 0.3 mg/ kg body weight twice a day or tolterodine chloride (Detrusitol) 0.1 mg/kg bw twice a day or subsequent intravesical administration of oxybutynin (Systral) 0.3 mg/kg bw daily with increasing dosages of up to 0.9 mg/kg bw daily.

Technique

- Fill the bladder to the half of the age-related capacity.
- delute 100 U of toxin in 10 cc of normal saline.
- Use the 3.7-Fr 25-cm-long polytetrafluoroethylene-coated injection needle (Wiliams needle, Cook Urological).
- Inject 10 U botulinum-A toxin (BTX-A) cystoscopically into the detrusor at each of the 25–30 sites all over the bladder, randomly.

Tips and Tricks

- Prepare the solution and calculate the dosage (dosage ranges from 10 U/kg to a maximum of 360 U) before starting the procedure.
- Avoid injecting the solution intraperitoneally.
- Empty the bladder after the endoscopic treatment and start clean intermittent catheterism (CIC) again on the same day.
- Stop anticholinergic treatment after injection therapy.

Maximum detrusor pressure decreases, maximum bladder capacity and detrusor compliance increase and the incontinence score improves. Many children are dry between the CIC intervals. Preliminary results report a therapeutic effect that lasts proximately 9–12 months.

Endoscopic Incision of Ureteroceles

A ureterocele is a congential cystic dilatation of the intravesical ureter and is more frequently seen in females; 80% are associated with the upper pole of a duplex system; 10% of ureteroceles are bilateral. The intravesical ureterocele is located entirely within the bladder; the ectopic ureterocele is located at the bladder neck or within the urethra. Treatment depends on the type of ureterocele and the mode of presentation. Endoscopic incision is indicated in newborns or infants with uni- or bilateral ureteroceles and dilated and obstructed upper urinary tracts as well as in all children with urosepsis and bladder outlet obstruction. More than 50% of these patients need additional open surgery.

Operative Technique (Step by Step)

- Intraoperative antibiotic prophylaxis.
- Insert a 7.5- or 8.5-Fr urethrocystoscope with working channel.
- Identify the ureterocele, the orifices and the bladder neck.
- Insert a 3-Fr Bugbee electrode or the metal stylet of a urethral catheter.
- Make a small limited incision (»smile«) or puncture on the medial, anterior wall close to the level of the bladder neck.
- Provide a clean, full-thickness puncture of the ureterocele wall.
- When incising an ectopic ureterocele, perform the incision at the most distal part of the ureterocele to allow adequate drainage.
- Optional transurethral bladder drainage.

Tips and Tricks

- If the ureterocele is collapsed before the incision procedure started, squeeze the ipsilateral flank (kidney) of the child from outside to fill the ureterocele.
- Caeco-ureteroceles and sphincteric ureteroceles can be unobstructed by vertically incising the meatus and extending it above the bladder neck.

Complications

- De novo reflux (VCUG 3 months postoperatively).
- Persistence of obstruction.

Endoscopic Treatment of Posterior Urethral Valves

Posterior urethral valves are the most common congenital course of bladder outlet obstruction. The diagnosis is made by a voiding cystourethrogram and it cannot reliably made by cystoscopy. Typical findings on the VCUG include a dilated prostatic urethra, a thick-walled trabeculated bladder and a hypertrophic bladder neck. Common associated anomalies are vesicoureteral reflux, bilateral hydronephrosis and the vesicoureteral reflux/renal dysplasia (VURD) syndrome (valves, unilateral reflux, renal dysplasia). This syndrome denotes massive unilateral reflux into a dysplastic nonfunctioning renal unit. Occasionally urinary ascites or perirenal urinoma is found due to renal fornix rupture.

Once the diagnosis of posterior urethral valves is suspected on ultrasound, the first step in the management after VCUG is a temporary suprapubic drainage of the urinary tract.

Endoscopic Valve Management (Step by Step)

- Place the infant in supine lithotomy position.
- Warm the infant.
- Calibrate the meatus (narrowest point of the urethra).
- Dilate the meatus gently to. 9 Fr.
- Insert the 8.5-Fr instrument under vision into the urethra.
- Incise the valves with the hook knife at the 12, 4, 8 o'clock positions.
- Place a transurethral catheter (24–48 h).

Tips and Tricks

- Do not insert an endoscope in a male newborn or young infant's urethra without calibrating or dilating the meatus in advance.
- Keep the suprapubic tube open during the entire procedure.
- Visualize the valves endoscopically by pressing the bladder suprapubic.
- Leave the valve remnants behind and do not fulgurate the remaining tissue in order to prevent strictures.
- Perform a vesicostomy if the caliber of the urethra in a small premature newborn is less than 8 Fr.

Complications

- Balloon-catheter placement in the prostatic urethra.
- Urethral strictures.
- Meatal stenosis.

Recommended Reading

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Image Gallery

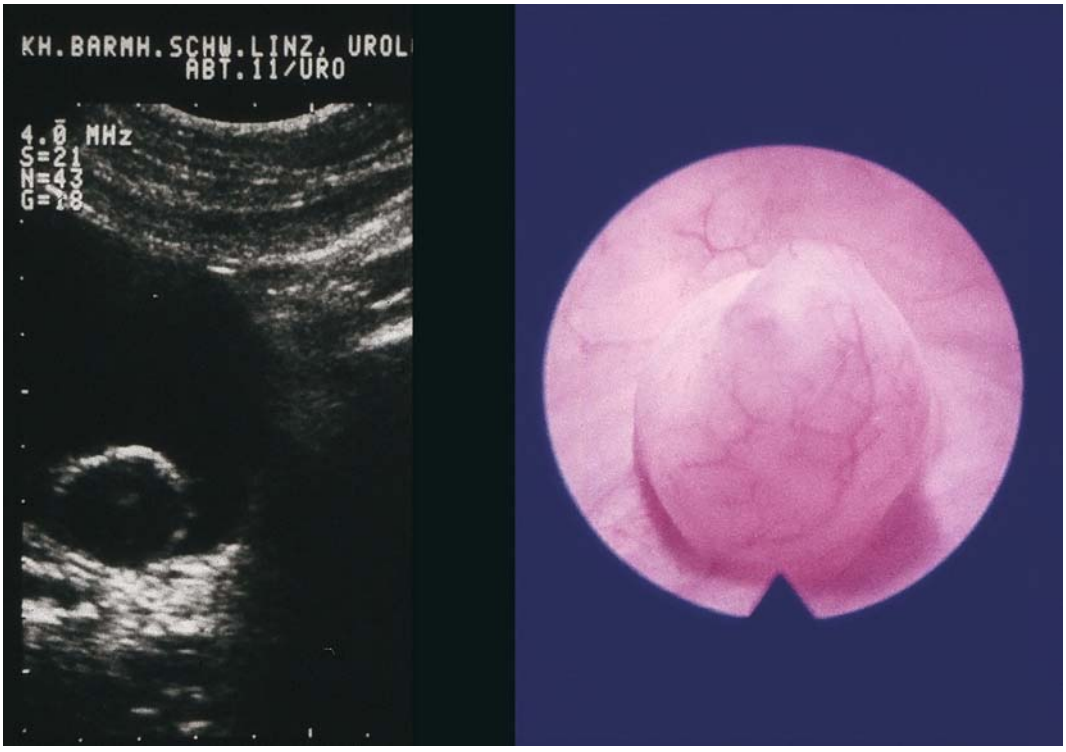


Fig. 5.1. Ureterocele: endoscopic and ultrasound image

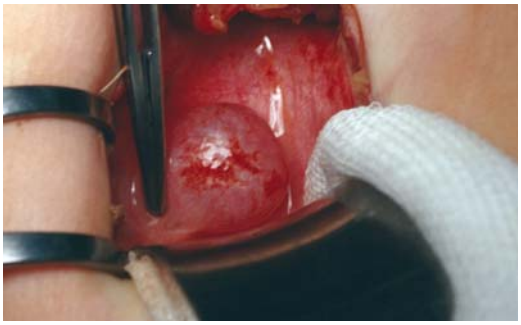


Fig. 5.2. Ureterocele: intraoperative view

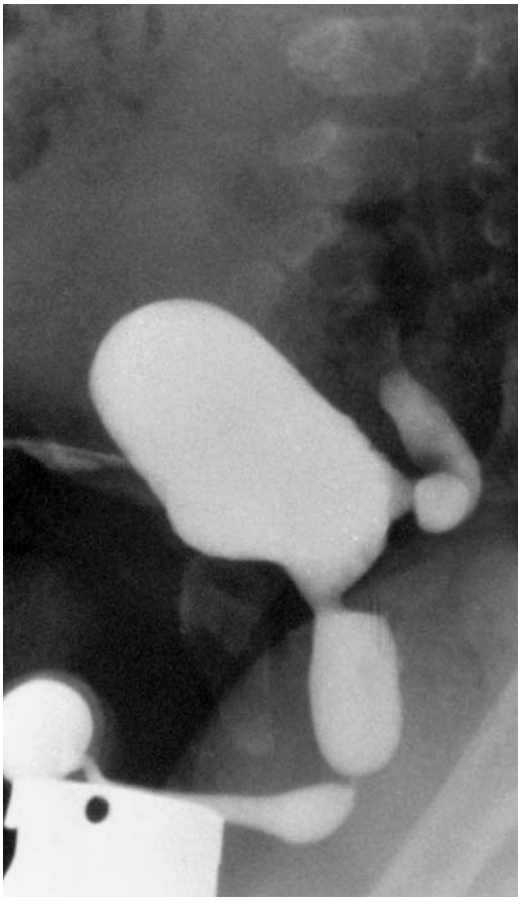


Fig. 5.3. Urethral valve: MCUG; additional finding: VUR left side

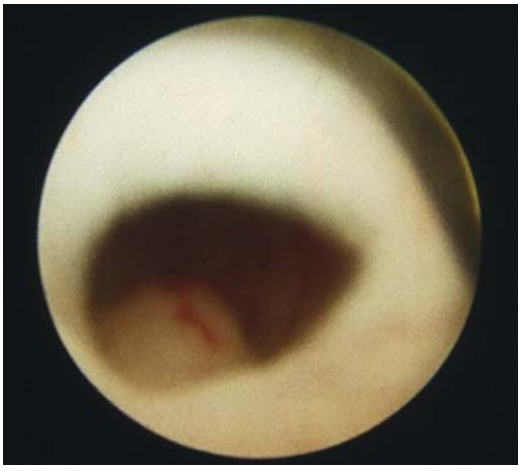


Fig. 5.4. Posterior urethral valve

Fig. 5.5. Posterior valve after endoscopic therapy

Fig. 5.6. Refluxive ureteral orifice

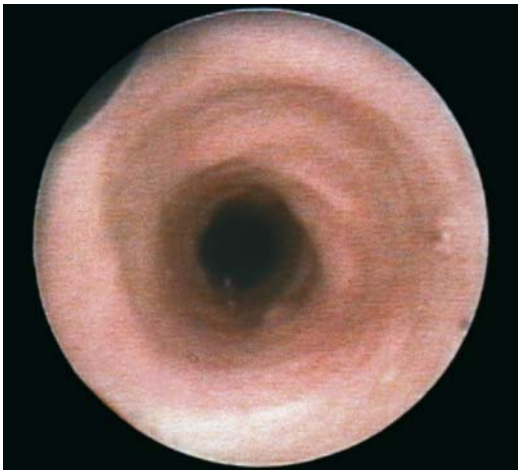


Fig. 5.7. Endoscopic view of the urethra after surgical reconstruction with buccal mucosa

Fig. 5.8. Ureteral orifice in MAINZ-Pouch II

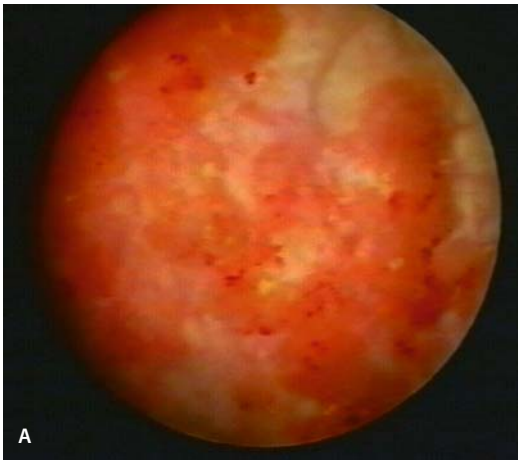


Fig. 5.9A, B. Endoscopic finding of a patient with cystitis glandularis showing miliary multiple polypoid lesions (**A**) and a major polypoid lesion resembling a bladder tumour (**B**), BJU International, 95(3):411–413

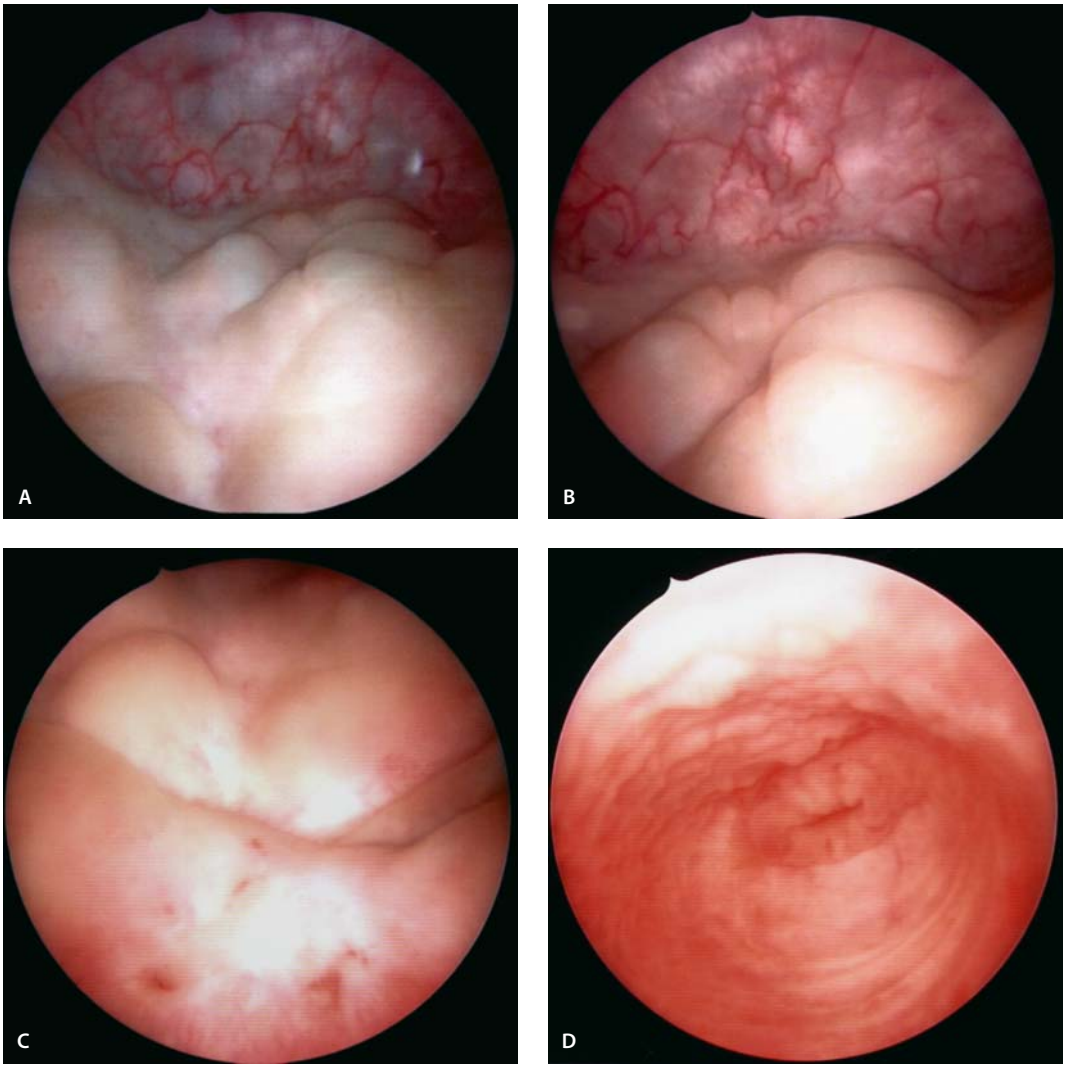
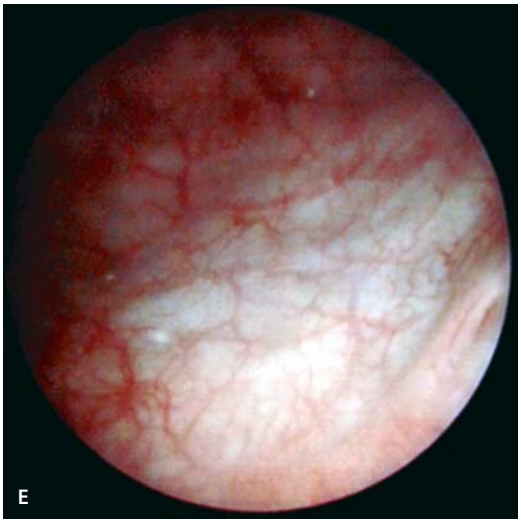


Fig. 5.10A–D. Eosinophil cystitis as a symptom of an idiopathic hypereosinophilia syndrome (courtesy of R. Nofal, Department of Urologie, Borromäus-Hospital Leer). Tumourlike induration at the bottom of the bladder (**A**). Tumourlike induration of the ureteral orifice, left side (**B**). Induration of the ureteral groin (**C**). Endoscopic view of the vagina (**D**).



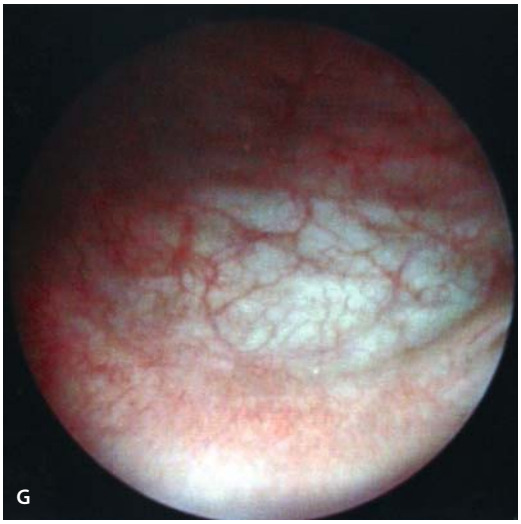


Fig. 5.10E–G. Endoscopic view after 2 months; self-limited process of the bladder (**E**). Endoscopic view, ureteral orifice, right side (**F**). Ureteral groin after healing (**G**)

Laparoscopy for the Undescended Testicle

Ulrich Humke, Stefan Siemer, Roland Bonfig, Mark Koen

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Introduction

Cryptorchidism is a frequent diagnosis in pediatric urology and a well-known risk for male infertility and testicular malignancy. About 20% of undescended testicles are not palpable. Although the mean age of children presented for therapy with cryptorchidism is above 3 years, the ideal time-point for effective preservation of fertility is between 12 and 24 months of life. Laparoscopy has evolved in the past years as the method of choice for the diagnosis and treatment of non-palpable testes. Clear advantages of laparoscopy with regard to specificity and sensitivity have been shown compared to ultrasonography and magnetic resonance imaging in detecting intra-abdominal testes. The purposes of laparoscopy for non-palpable testes are (a) localization and evaluation of the missing testis, (b) orchiopexy (one- or two-stage procedure) and (c) orchiectomy (if indicated), each selected alone or in combination for the individual case.

Patient Counselling and Consent

- Risk of vascular or intestinal injury during primary trocar placement.
- Risk of hernia formation at the trocar site postoperatively (depends on trocar size).
- Eventually intraoperative need for conversion to open conventional surgery.

Preoperative Preparation

- Beta-HCG stimulation test only in case of bilateral non-palpable testes.
- Standard bowel preparation.

Anaesthesia

- General anaesthesia.

Indications

- All cases of non-palpable testes: integrated concept of diagnostic laparoscopy combined with open surgery (revision of inguinal canal, with or without orchiopexy) or combined with therapeutic laparoscopy (staged orchiopexy or orchiectomy for intra-abdominal testes).
- Suspected intersex (laparoscopy for diagnosis, eventually biopsy and/or orchiectomy).

Limitations and Risks

- Smaller body size in children implies smaller space tolerances of the abdominal wall, which makes standard trocar placement more dangerous.
- Looser attachments of the peritoneum to the extraperitoneal structures in children make trocar penetration more difficult.
- A dull trocar is a potentially dangerous instrument in children.

Contraindications

- Acute infectious disease.
- Coagulopathy.
- Prior abdominal surgery with suspected adhesions.

Special Instruments

- Laparoscopy unit (video cart) with insufflator, light source, video camera, video monitor, video recorder and electrocautery unit.
- Veress cannula.
- Mini-laparoscope (1.9 mm) with 2.7-mm trocar shaft, for older children 3.5 or 5-mm laparoscopes.
- 3.5-mm trocars and laparoscopic forceps/graspers/scissors for dissection, for older children 5-mm trocars and instruments.
- 5- or 10-mm clipping instruments.

Operative Technique (Step-by-Step)

Placement and Removal of Trocars

- Supine and 10° head-down position of the patient.
- Gastric tube and bladder catheter in place.
- Small infraumbilical skin incision reaching the fascia.
- Elevation of the abdominal wall by lifting up a skin fold or two forceps-clamps on both sides of the umbilicus.
- Intraperitoneal insertion of the Veress cannula covered with mini-trocar (mini-laparoscopy set): vertical direction of puncture.
- Replacement of Veress cannula with mini-telescope.
- Optical control of correct intraperitoneal position of laparoscope.
- *Thereafter* start of CO_2 insufflation and creation of pneumoperitoneum (maximum pressure, 12 mmHg).
- Inspection of peritoneal cavity and anatomical landmarks, exclusion of puncture related iatrogenic injuries.
- Alternative access method: Hasson technique for trocar insertion (preferred by many pediatric urologists): Dissection and incision of fascia and peritoneum with scissors under direct vision. After opening of the peritoneal cavity insertion of the trocar and fixation with suture.
- Remove trocars under laparoscopic view to exclude bleeding from the trocar canal.
- Remove intraperitoneal gas through the last trocar as completely as possible, slightly compress the lower thoracic aperture to mobilize gas from the upper peritoneal cavity, extract last trocar.
- Close fascia with single sutures at 10-mm trocar sites, close all skin incisions with single sutures.

Diagnostic Laparoscopy

- Identify anatomical landmarks: bladder (catheter balloon visible) and urachal ligament, lateral umbilical ligament, inferior epigastric vessels, inner inguinal ring, vas deferens, spermatic vessels.
- Check anatomical status relevant for cryptorchidism:
  - Inner inguinal canal open (open processus vaginalis) or closed?
  - Spermatic vessels and/or vas deferens present, passing into the inguinal canal or ending cranially?
  - Testicle intra-abdominal?
  - Testicle visible in the inguinal canal?
  - Testicle volume? Epididymal configuration?
- Classify anatomical findings into three therapeutic relevant categories:
  1. All spermatic cord structures are present and leave into the inguinal canal (frequent condition): stop laparoscopy and proceed with open surgery: revision of the inguinal canal, closure of open processus vaginalis, excision of atrophic testicle or rudimentary testicular structures (vanishing testis), alternatively orchiopexy of inguinal testicle.
  2. Spermatic vessels and vas deferens can be identified. They end blindly on the psoas muscle without any testis detectable (vanishing testis, anorchia: rare condition): stop laparoscopy, no further surgery.
  3. Intra-abdominal testicle present with or without open inguinal canal (frequent condition): proceed with laparoscopic orchiectomy, if testicle appears small and atrophic. Proceed with laparoscopic orchiopexy (one-stage procedure if testicle has a maximal distance to the inner inguinal ring of 2 cm) or clipping of spermatic vessels as first step of two-stage orchiopexy (Fowler Stephens manoeuvres I and II).

Primary Orchiopexy (One-Stage Procedure)

- Incise retroperitoneum with a minimal 1-cm margin laterally to the testicle and medially alongside the vas deferens.
- Mobilize peritoneum carefully across spermatic vessels.
- Leave all vessels around the vas deferens and the peritoneal plane between vas and vessels intact. Try to avoid electrocautery as much as possible.
- Mobilize the testicle carefully from the psoas fascia towards the inguinal ring.
- Create new internal ring medially to the epigastric vessels (shortens the overall distance to the scrotal position).
- Make an incision at the lower pole of the scrotum and provide a dartos pouch. Insert a laparoscopic grasper, guide it through a tunnel to the new inguinal ring, take the mobilized testicle and pull it into the scrotum without forced tension.

Fowler Stephens Step I (Clipping of Spermatic Vessels)

- Incise retroperitoneum bilaterally parallel to the spermatic vessel, minimum 2 cm cranially to the upper pole of the testicle.
- Mobilize spermatic vessels, hold them up with a grasper and apply two absorbable clips without dividing them.

Fowler Stephens Step II (Secondary Orchiopexy)

- Plan this procedure not before 6 months after the first step.
- Dissect the clipped area of the spermatic vessels and divide them.
- Incise retroperitoneum with a minimal 1-cm margin laterally to the testicle and medially alongside the vas deferens. The peritoneal flap remains pedicled to the vas deferens.
- Leave all vessels around the vas deferens and the peritoneal plane between vas and vessels intact. Try to avoid electrocautery as much as possible.
- Dissect gubernaculum as far distally as possible.
- Mobilize the testicle carefully from the psoas fascia towards the inguinal ring.
- Create new internal ring medially to the epigastric vessels.
- Make an incision at the lower pole of the scrotum and provide a dartos pouch. Insert a laparoscopic grasper, guide it through a tunnel to the new inguinal ring, take the mobilized testicle and pull it into the scrotum.

Orchiectomy

- Indicated for small, atrophic intra-abdominal testicles.
- Incise retroperitoneum and dissect spermatic vessels after clipping cranially.
- Mobilize testicle and vas deferens.
- Dissect vas deferens after coagulation.
- Free the testicle from remaining peritoneal adhesions and extract it via an 5- or 10-mm trocar with a strong grasper.

Tips and Tricks

- Start laparoscopy in children with mini-laparoscope: risk of initial trocar injury minimized, sufficient for diagnostic purpose, change to bigger trocars for further therapeutic laparoscopy easily and safely possible.
- Apply gastric tube and bladder catheter before start of operation to minimize risk of organ injury during initial puncture of the abdomen.
- Insert working trocars always under optical guidance.
- Prevention of a foggy laparoscope: warm the instrument moderately before use, clean it intraoperatively by sweeping smoothly along a peritoneal/intestinal surface.
- Remove trocars under endoscopic vision to control bleeding.

- Use absorbable sutures for closure of skin incision.
- Have instruments for open surgery available in the operating room for emergency cases.

Postoperative Care

- Appropriate analgesia.
- Start of oral feeding 6 h after anaesthesia.
- Start of mobilization according to the child's activity, except after orchiopexy of an intra-abdominal testis (bed rest minimum 24 h).
- Perform Duplex-sonography postoperatively to control testicular perfusion.
- Give oral antiphlogistic medication to limit postoperative swelling if necessary.

Complications

- Intestinal injury during initial blind trocar placement: obvious intestinal injury has to be revised and treated by open surgery.
- Vascular injury during initial blind trocar placement: obvious vascular injury has to be treated by immediate conversion to open surgery.
- Ureteral injury during careless mobilization of intra-abdominal testis.
- After orchiopexy:
  - Loss of scrotal position due to excessive tension.
  - Testicular atrophy due to vascular malperfusion.

Do's

- Do primary one-stage orchiopexy if the testicle is located close to the inner inguinal ring (maximum 2 cm distance) and spermatic vessels appear mobile and elastic.
- Perform two-stage procedure if testicle is located proximally and spermatic vessels are too short for a one-stage procedure.
- Do Fowler-Stephens I laparoscopically.
- Do Fowler-Stephens II orchiopexy optionally as open surgery from a small suprainguinal incision.

Dont's

- Do not perform orchiopexy under forced tension. This will reduce testicular perfusion and provokes retraction of testicle.
- Avoid torsion of the vascular/peritoneal pedicle while pulling the testicle through the new inguinal canal.

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Image Gallery

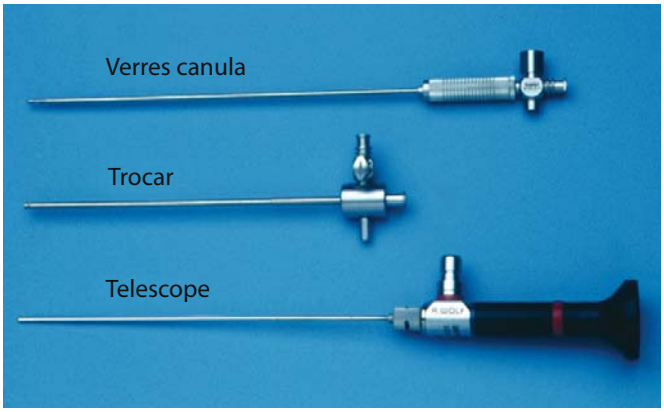

Fig. 6.1. Mini-laparoscopic instruments with Veress cannula, mini-trocar and mini-telescope (diameter of 1.9, 2.7 and 1.9 mm, respectively) for use in children

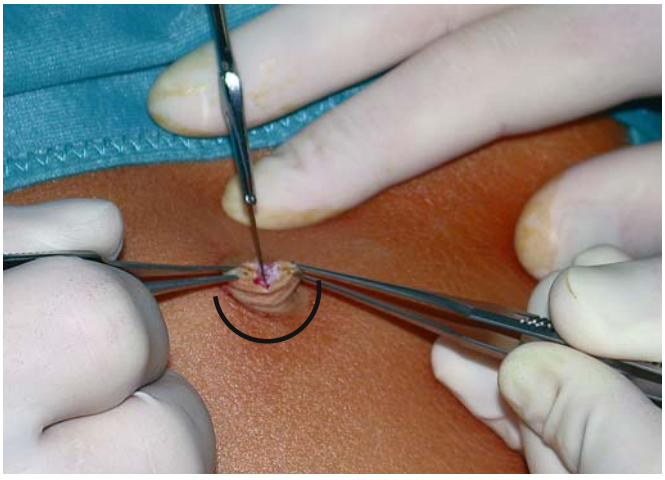

Fig. 6.2. Small, infraumbilical incision under elevation of the periumbilical skin. Through the incision, the abdomen may be directly punctured with the Veress cannula (classical approach)

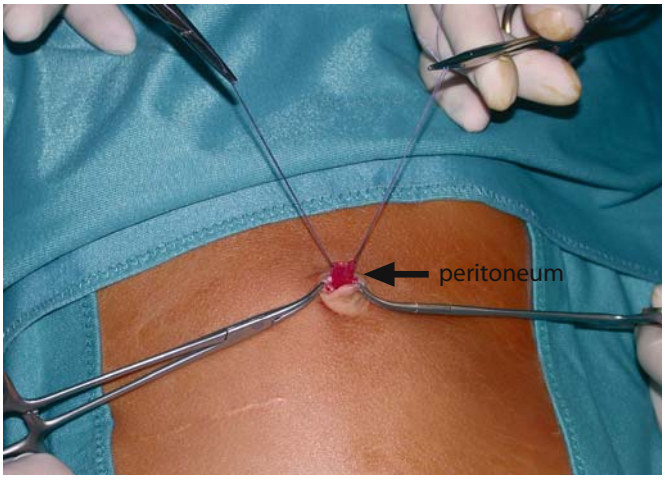

Fig. 6.3. Alternatively, for safety reasons, the peritoneum is dissected and incised under direct vision before the trocar is inserted directly into the abdominal cavity (Hasson technique)

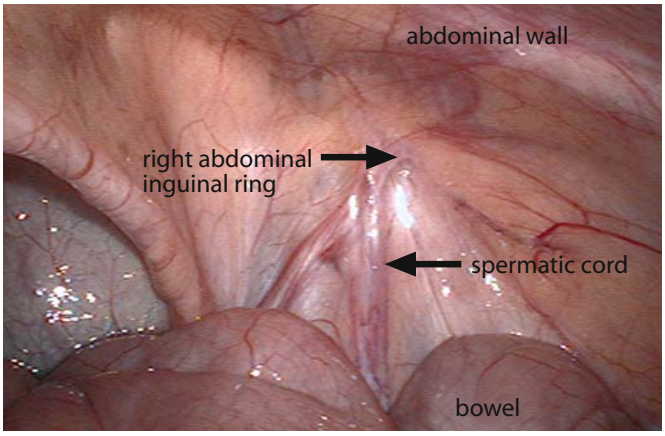

Fig. 6.4. Normal, closed right inner inguinal ring. Spermatic vessels and vas deferens join each other in an inverse V-shape before entering the inguinal canal. In this case of nonpalpable right testis, surgery proceeds with open inguinal exploration

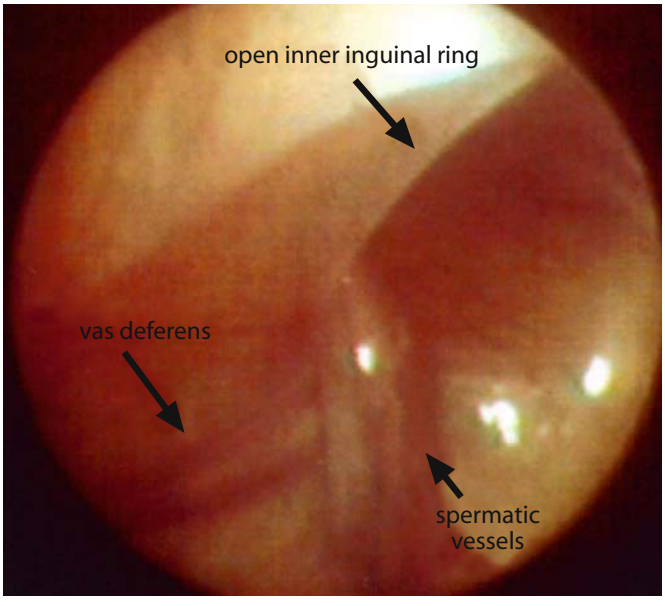

Fig. 6.5. Open right inner inguinal ring with spermatic vessels and vas deferens entering the open inguinal canal. In this case of nonpalpable right testis, surgery proceeds with open inguinal exploration

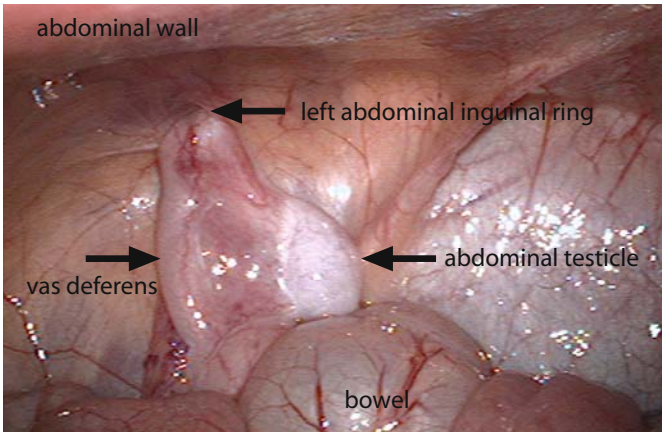

Fig. 6.6. Left inner inguinal ring with normal-sized intra-abdominal testis distally located on the external iliac vessels. Surgery proceeds with one-stage open or laparoscopic orchiopexy

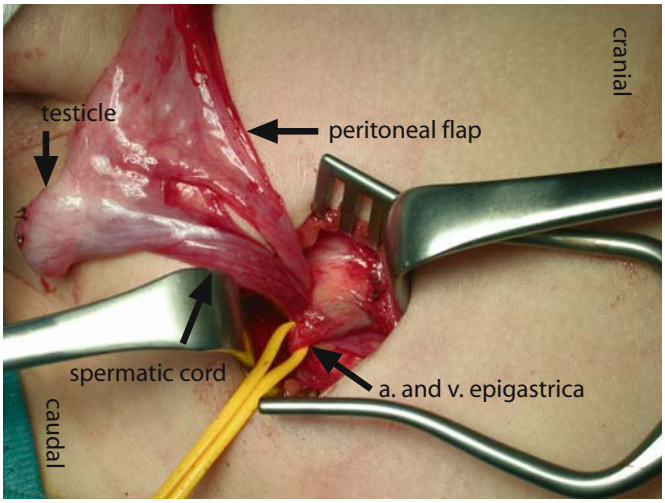

Fig. 6.7. Intraoperative situation during open orchiopexy of left distal intra-abdominal testis (see Fig. 6.6). Note the Prentiss manoeuvre (testicle and spermatic cord pass *under* the mobilized inferior epigastric vessels to gain length for tension-free orchiopexy)

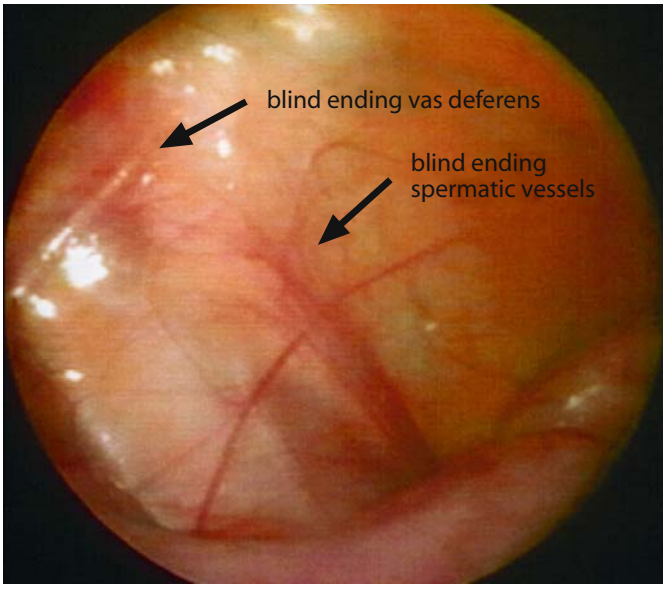

Fig. 6.8. Intra-abdominal right testicular aplasia: blind-ending spermatic vessels and blind-ending vas deferens. No further surgery needs to be performed

Transurethral Resection of Bladder Tumours

Armin Pycha, Salvatore Palermo

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Introduction

As the bladder tumour is the second most common tumour of the genitourinary system, the transurethral resection (TUR) is an intervention, which is often performed [1]. At first manifestation, 70%–75% of bladder tumours are superficial and well differentiated. The recurrence rate is 70% and out of these 6%–10% show a progression with an eventual lethal outcome.

The TUR of bladder tumours (TUR-B) has a double goal: first the total removal of papillary lesions; second to determine the depth of invasion or clinical stage [1].

TUR-B is often the first step for residents in their endourological training. From the technical point of view, new developments for video systems, optics, electrosurgical instruments and high-frequency (HF) generators facilitate TUR-B procedures. Nevertheless, TUR-B is burdened with a significant number of complications.

Indications

Any suspicious area in the bladder.

Contraindications

- Absolute contraindications for programmable TUR-B are uncorrected coagulopathy and active urinary tract infection.

In case of severe bleeding of bladder tumours, there is a vital indication for TUR-B. At the same time, the coagulopathy must be corrected by the haematologist.

- Relative contraindications: anaesthetic contraindications.

Preoperative Preparation

- Stop aspirin 1 week before operation.
- Rule out and treat any urinary tract infection by urine culture and sensitivity.
- Thrombosis prophylaxis commencing the evening before the operation (low-molecular-weight heparin).
- Rectal enema is used the day before the operation.
- Intravenous single-dose antibiotics at induction.
- Counseling and informed consent.

Anaesthesia

- General anaesthesia with muscle relaxation.
- Spinal anaesthesia.

Instruments

All instruments (1–17) used are from Karl Storz, Tuttlingen, Germany.

- Latest-generation electrosurgical generator (*1*)
- Digital video camera controller IMAGE1 (*2*) with 3-CCD digital pendulum camera head IMAGE1 P3 (*3*).
- 18" TFT-flat screen monitor with digital SDI input (*4*).
- High-intensity 300-W Xenon light source (*5*).
- Hopkins II Telescope 0° (*6*), 30° (*7*), and 70° (*8*).
- Working element, passive (*9*).
- Resectoscope sheath 24-Fr single flow with central valve (*10*) or resectoscope sheath 26-Fr, continuous flow, rotatable (*11*) visual obturator (*12*).
- HF resection electrodes:
  - standard vertical loop (*13*).
  - Straight (longitudinal) loop (*14*).

  - Roller ball electrode for coagulation, 3 mm in diameter (*15*).
- HF biopsy forceps (*16*).
- 100-ml bladder syringe (*17*).
- 18-Fr irrigation catheter.
- Lubricant (Instillagel®, Farco Pharma, Germany).
- Electrolyte-free, sterile, and isotonic irrigation fluid, positioned at a height of 50–60 cm above the pubic symphysis.

Patient Positioning

- Lithotomy position.
- The thighs must be bent at an angle of 90° from the hip to guarantee the resectionist enough manoeuvrability.
- The gluteal muscles must be exactly at the edge of the operating table.

Run through the check-list before starting the operation.

Operative Technique (Step by Step)

- White balance of the video camera.
- Adjustment of the video zoom and focus.
- Enter the bladder with a visual obturator and check the urethra.
- Perform a first inspection of the bladder following a strict protocol and compare these findings with the records of the outpatient clinic.
- Assertion of the number of lesions.
- Resectoscope working element with a 30° telescope is introduced.

In reliance on localization and extensions of the tumor, different resection techniques can be used.

Resection Procedure according to Nesbit (1943)

- The bladder is filled to half of the maximum capacity (use of continuous-flow resectoscope facilitates the maintenance of optimal bladder filling).
- Resection starts at the lateral border of the tumour.
- String one loop strip after another in a horizontal plane.
- On completion of one plane, the next deeper plane follows.
- Resect until healthy tissue is reached.
- Small tumours can be cut at the level of the pedicle, then the specimen is evacuated by bladder washing.
- Thereafter, a loop-strip of the residual pedicle and the underlying submucosa and detrusor is taken and sent separately to histology.
- Bladder evacuation with a 100-ml syringe.
- Meticulous coagulation using a roller ball electrode.

Limits

- Tumours on the bladder dome are technically difficult to manage using this technique.
- The identification of tumor base and higher tumor planes can create problems.
- The loop-strips on the bottom normally show severe fulguration artefacts compromising the histological evaluability.

Risks

- Often clear staging is not feasible.
- Exact evaluation of resection borders is often difficult and sometimes speculative.

Tricks

- Resection should proceed with partially distended bladder.
- Take care to follow the curve of the bladder when resecting to avoid perforation.
- Treat easily accessible and small tumours first.

- Reserve tumours on the bladder dome and anterior wall for the end.
- Resection on bladder dome and anterior wall can be facilitated by suprapubic pressure with the second hand.
- After completed resection of one lesion, ensure perfect coagulation before starting with resection of the next lesion.

En Bloc Resection according to Mauermayer (1981)

- Use a straight loop.
- Cutting power is reduced to 60 W.
- A circular coagulation mark at a distance of 5 mm from the tumour pedicle is set around the lesion.
- At this mark, an incision in the bladder wall is made to arrive at the deep muscular layer.
- By stepwise cutting, the bladder wall cuff is isolated.
- Completion of the resection.
- The tumour is retrieved using a syringe.
- Careful coagulation of the tumour ground with a roller ball electrode.

Limits

- Only papillary tumours with a diameter of not more than 2.5 cm can be removed using this technique.
- Never use this technique in the bladder dome and anterior wall.
- Tumours in a diverticulum cannot be managed with this technique.

Risks

- On the posterior circumference, the coagulation mark is difficult to identify during cutting. Check repeatedly.
- Lesions larger than 3 cm in diameter cannot be retrieved.

Tricks

- Using the shaft or the irrigation flow, the lesion can be inclined backwards. The angle between the bladder wall and lesion increases and therefore the resection is much easier.
- Using a resectoscope with a »short beak shaft« facilitates the inclination of the tumour, guaranteeing optimal vision.

Bladder Mapping

- If a negative cystoscopy is in contrast to a positive cytology, a bioptical evaluation of the bladder is mandatory.
- A cold biopsy forceps is inserted through the 24-Fr sheath.
- On filling half of the bladder, the branches of the forceps are opened.
- With gentle pressure to the bladder wall, the branches are put on the mucosa.
- The branches are closed and the closing mechanism on the bottom of the sheath is opened and the forceps retrieved.
- The specimen is removed from the branches.
- The forceps are reinserted in the sheath and the biopsy area is coagulated.
- Repeat this procedure at least at the bottom of the bladder and the anterior, posterior and both lateral walls as well as on the bladder dome.

Before Finishing TUR-B

- Check again for perfect coagulation.
- Ascertain that there is no deficit in irrigation fluid.
- Place an 18-Fr irrigation catheter and wash the bladder three times with 100 ml saline solution. Continuous irrigation is not normally needed.
- Ensure the function of the catheter, which is essential!
- Palpate the abdomen to ensure no increase of circumference.

After Finishing TUR-B

- Check the catheter function again.
- Complete the check list.
- Write the operation report immediately.

Postoperative Care

- Continued irrigation of the bladder is not normally necessary, otherwise irrigate overnight.
- When the urine becomes clear and there is no complication, the catheter can be removed. Normally after 24 h.

Common Complications

Bleeding

- Meticulous haemostasis is necessary to prevent bleeding as well as a perfect functioning catheter.
- Check catheter function.
- Remove blood clots.
- Perform bladder washing by hand.
- If this approach is not successful, return to the operating theatre. Waiting does not make sense.

Perforation

- Causes:
  - Full-thickness bladder wall resection (very frequent).
  - Overdistension (rare).
  - Perforation with the resectoscope (seldom).
- Signs:
  - Inability to distend the bladder.
  - Deficit of irrigation return.
  - Abdominal distension.
  - Endoscopically visualization of fat or a dark spot in the posterior bladder wall or at the bladder dome.

Trouble-shooting

Extraperitoneal Perforation

- Exact endoscopic inspection.
- Reduce irrigation as much as possible.
- Meticulous coagulation; take care of bleeding vessels in the fat.
- If there is any doubt make a cystogram.
- No irrigation or as little as possible.
- 22-Fr catheter.
- Antibiotic treatment.
- Before removal of the catheter after 5 days, check cystogram.

Intraperitoneal Perforation

- Small intraperitoneal perforation can be managed as a extraperitoneal one.
- If abdominal distension is present and bleeding is under control, stop resection.
- Insert a 10-mm laparoscopic port midway between umbilicus and the anterior superior iliac spine.
- Insert a drain through the port.
- Remove the port and fix the drain.
- Place a 22-Fr transurethral catheter.
- No irrigation.
- After 10 days, check cystogram and removal of the catheter in absence of leakage.
- If the bleeding is not controllable, perform an inferior laparotomy.
- Close the bladder defect with Monocryl 3/0 single stitches.
- Place an intraperitoneal and an extraperitoneal drain.
- Double drainage of the bladder with transurethral and suprapubic catheter.
- After 7 days, check the cystogram and remove the catheter.

Obturatorius Nerve Stimulation

- An obturatorius reflex provokes an adductor contraction.
- To prevent the reflex, reduce the cutting power from 100 W to 70 W.

Damage to the Ureteric Orifice

- The ureteric orifice can be resected if there is tumour involvement.
- Consequence is a VUR.
- To avoid stenosis near the orifice, no coagulation should be used.
- If there is any doubt, a guidewire should be inserted and a D-J stent placed.

Postoperative Complications

- Haematuria (see above).
- Clot retention (see above) leading to a blocked irrigation catheter. Beware, the clot may lead to 'short-circuiting' of the irrigation fluid and can give a false impression of clear effluent.
- Urinary tract infection (documented by culture) including epididymitis.

New Developments

Bipolar Transurethral Resection in Saline

Saline is the irrigation solution. No patient plate is necessary. A new class of resectoscope, combined with a special bipolar high-frequency generator (autocon II 400, KARL STORZ, Germany), which integrates both electrodes within the instrument, making the patient return plate unnecessary. Since the high-frequency current is delivered via the resection loop to a second loop, there is no uncontrolled flow of current through the patient's body. Due to the use of saline as irrigation medium, the risk of TUR syndrome or obturatorius reflex is significantly reduced.

Comments

The first, normally office-based, cystoscopy is of fundamental importance when it comes to making a decision:

- If there are papillary superficial tumours, then a TUR with diagnostic and curative intention should be performed.
- Proper documentation is essential and helps the urologist in the operation room (photo documentation or drawings).
- A large infiltrating solid tumour surrounded by an oedema bullosum needs only a representative biopsy for further radical surgery, even a cold one is enough to confirm the initial suspicion of an invasive, highly malignant tumour.
- A positive cytology and a negative cystoscopy and/or a flat dark reddish spot requires bladder mapping.
- Measurement of the full bladder capacity is mandatory. A reduced capacity is an indirect sign of an infiltrating tumour, interstitial cystitis or an irradiated bladder.

Remember

- The histological grade is the most important prognostic factor. High-grade tumours (G3) are mostly infiltrating the lamina propria.
- The majority of overlooked tumours are located at the bladder dome and anterior wall.
- Highly malignant (G3) tumours are bad tumours. The chance of being cured by TUR alone is minimal. The delay by multiple TURs is often a reason for the late performance of cystectomy.

Do's

- In case of a catheter blocked by blood clots, return to the operating room where you have all the equipment necessary to deal with the problem.
- Use general anaesthesia in tumours located on the side wall or the dome of the bladder as the local anaesthesia of the N. obturatorius

is sometimes insufficient, carrying a risk of bladder perforation.
- In asymptomatic patients with recurrent small pedicled papillomas found by routine cystoscopy monitoring, a wait-and-see strategy can be considered.

Dont's

- Repeat irrigation or change a blocked catheter on the ward.
- Repeated TUR-B in G3 tumours.
- Never face a complication without the right equipment.

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CHECK – LIST

Preoperatively

- ☐ Cystoscopy report
- ☐ i.v. Pyelography
- ☐ Blood count and chemistry
- ☐ Coagulation parameter
- ☐ Informed consent
- ☐ Anaesthesiological visit

In the operation room

- ☐ Instrument check
  - 24/26-Fr resectoscope sheath
  - Passive working element
  - Visual obturator
  - Horizontal and vertical loop
  - Ball electrode
  - Cold cup forceps
  - 100 ml syringe
  - 0°, 30° and 70° optics
  - 18-Fr irrigation catheter
- ☐ Cautery:
  - ☐ Cutting 150 W
  - ☐ Coagulation 70 W
- ☐ Lithotomy position
- ☐ Coagulation plate
- ☐ Barbotage
- ☐ Check office protocol/numbers of lesions

After resection

- ☐ Catheter function
- ☐ Abdominal palpation
- ☐ Resection protocol

OPERATION REPORT

Patient:

Born: Sex: CRA:

16/06/2004 08.00 **Procedure: TUR-B**

Manifestation	First
Exposition	No
BCG	No
Chemotherapy	No
Anaesthesia	Spinal
Surgeon	Pycha, Armin Univ. Prof. Prim. Dr. Specialist
Impression	Low risk

Characteristics
Superficial
Papillary
Wall extended

Treatment
Mapping
TUR-B
Coagulation

Type of TUR-B	Staging

Instruments used
Resector (24-Fr), standard loop

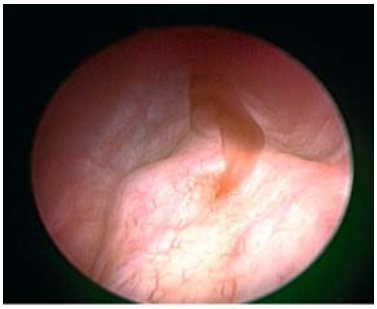
Description
Inspection with the resectoscope 24-Fr and barbotage. From the left ureter orifice deep reddish urine is ejaculating. The complete hemitrigonum on the right side is covered in papillary structures. The right orifice is involved in this tumour.
Three deep TUR strips are taken for staging purposes, the rest is coagulated with the ball electrode sparing the right orifice.
Placement of 18-Fr Dufour washing catheter. The washing solution is clear.

Complications
None

Special remarks
Farmarubicin single shot
Bleeding from left orifice

Cytology	Positive

Surgeon
Pycha, Armin MD.



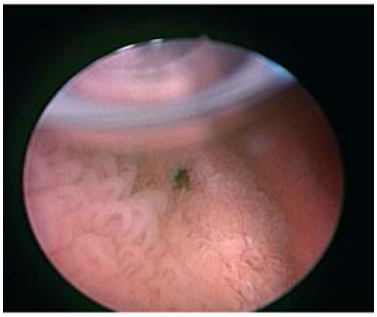


Image Gallery

Fig. 7.1. Instruments for TURB (all equipment is from Karl Storz, Tuttlingen, Germany)

Fig. 7.2. Typical lithotomy position of the patient and arrangement of the equipment

Fig. 7.3. Exophytic, papillary tumour with broad pedicle

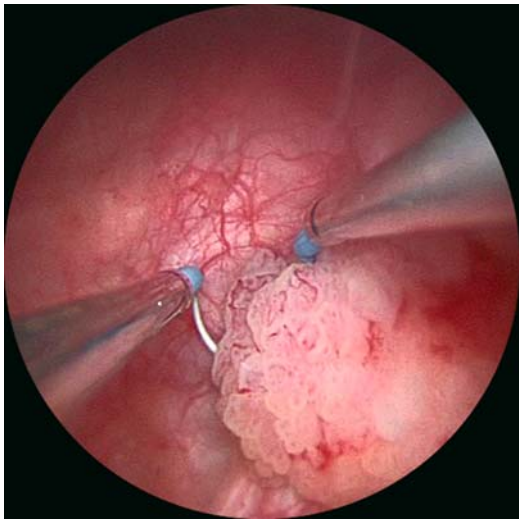


Fig. 7.4. Resection of a papillary tumour with Nesbit technique. The loop is placed behind the exophytic part of the tumour

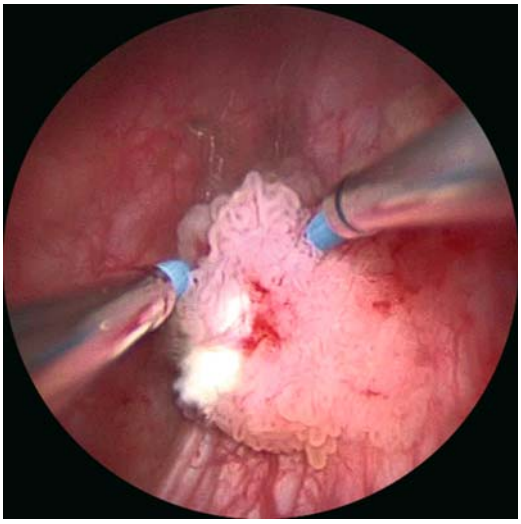


Fig. 7.5. Cutting of the first strip, starting at one edge

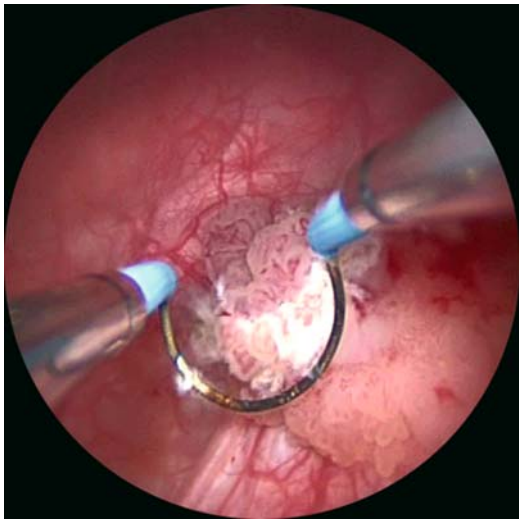


Fig. 7.6. The first strip is completed

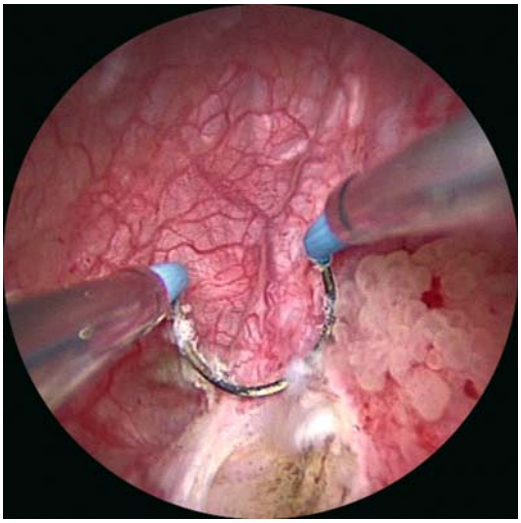


Fig. 7.7. Removal of the edges of the tumour basis

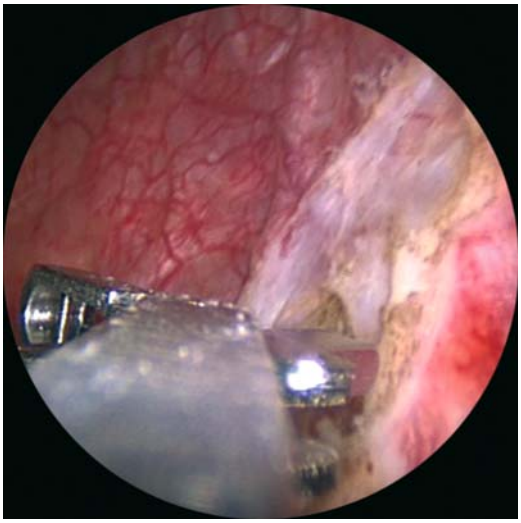


Fig. 7.8. Cold biopsy of tumour bottom and margins

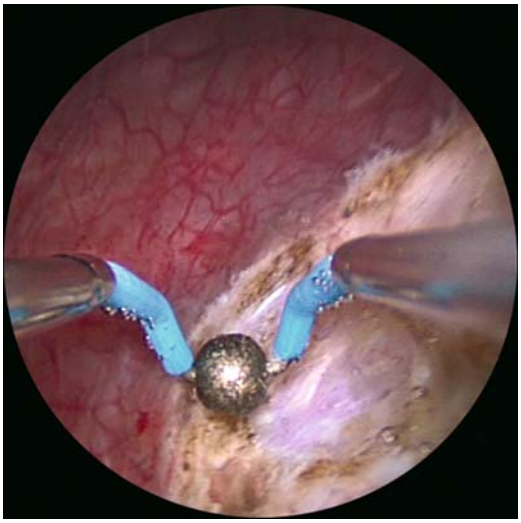


Fig. 7.9. Deep coagulation by ball electrode

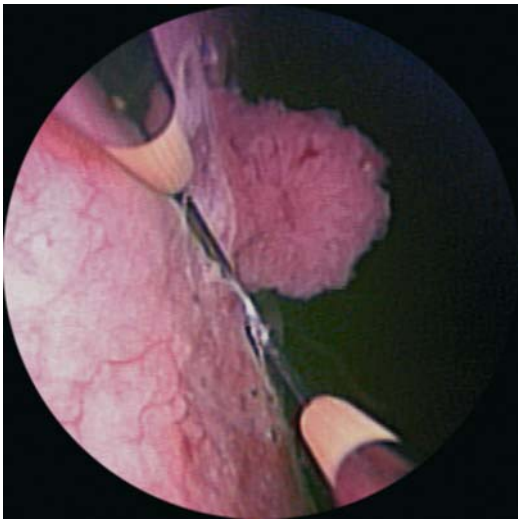


Fig. 7.10. Exophytic, papillary tumour with broad pedicle. Flat loop technique. Mucosa is incised

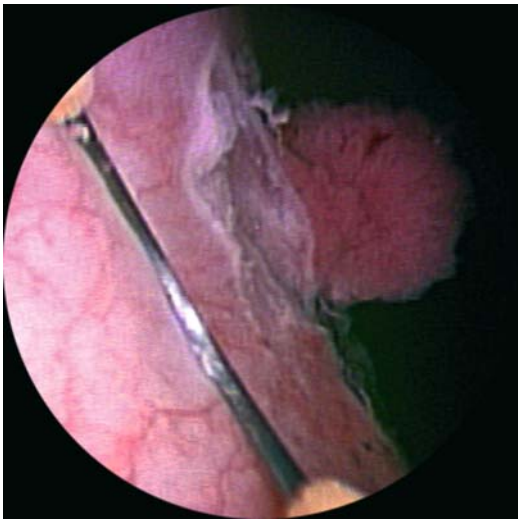


Fig. 7.11. The cutting procedure proceeds into the detrusor muscle

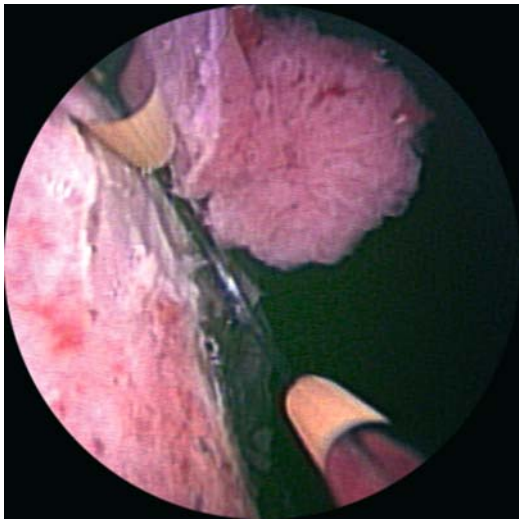


Fig. 7.12. Muscle cuff below the pedicle is developed

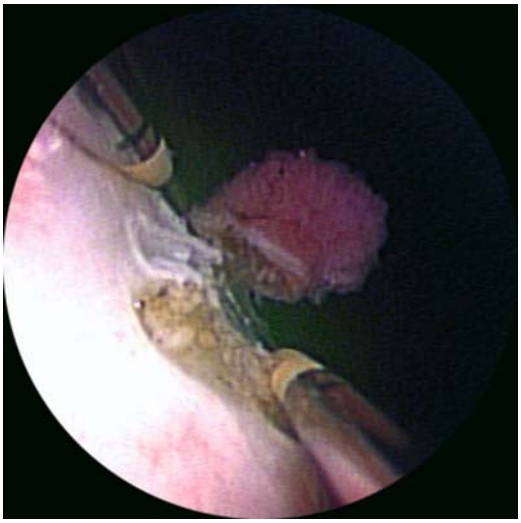


Fig. 7.13. The last attachments are cut

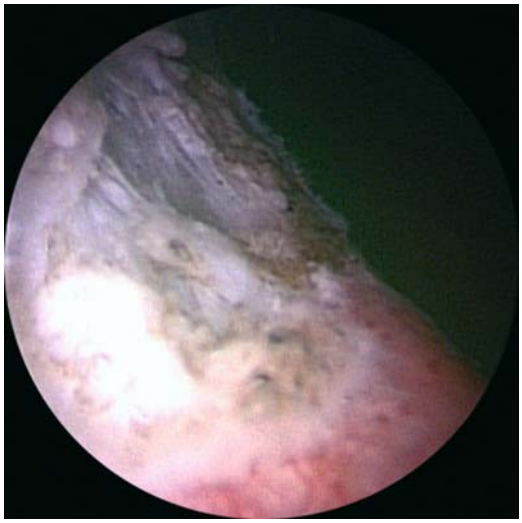


Fig. 7.14. Removal if completed and the resection basis is coagulated

Fig. 7.15. Urothelial pseudopapillary hyperplasia, located mostly at the bladder neck (typical sign: the vessels do not reach the tip of the lesion)

Fig. 7.16. Multiple flat papillary lesions (papillomatosis); removed by cold loop (shaving); histologically G0 lesion.

Fig. 7.17. Haemangioma cavernosum of the bladder

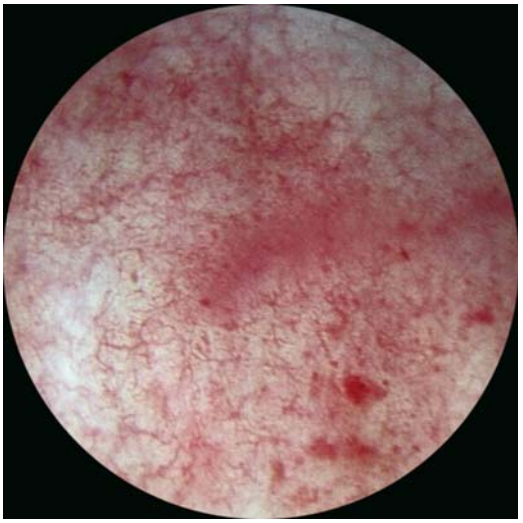


Fig. 7.18. Carcinoma in situ, typical red spot

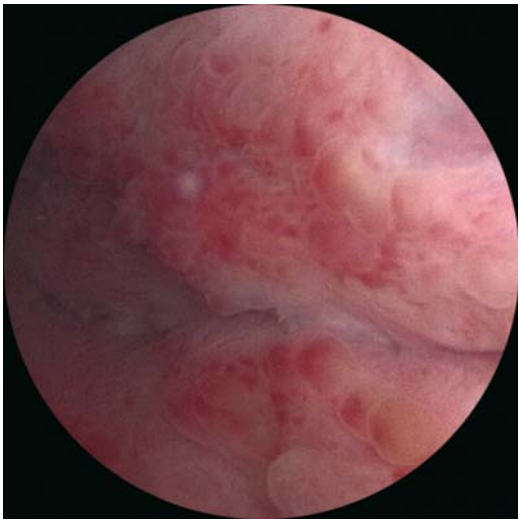


Fig. 7.19. Carcinoma in situ with oedema bullosum

Fig. 7.20. Inflammatory pseudotumour

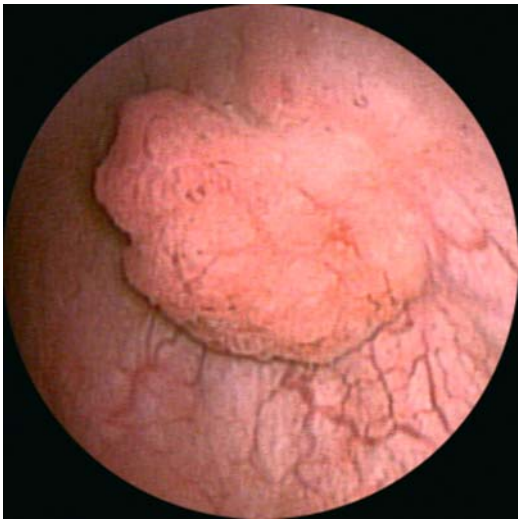


Fig. 7.21. Solid urothelial carcinoma

Fig. 7.22. Extravesical wall infiltrating malignant lesion, ovarian cancer

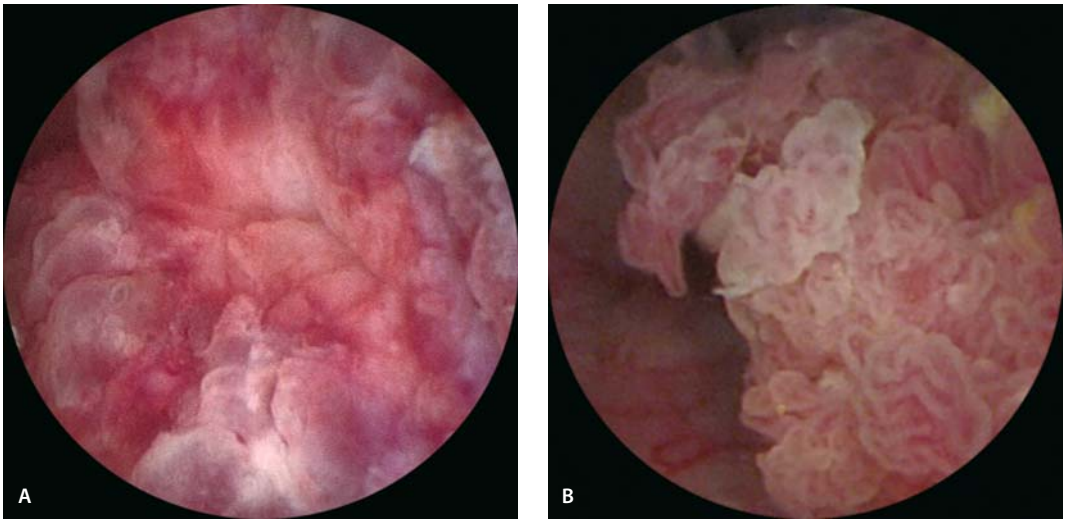


Fig. 7.23 A,B. Extravesical wall infiltrating inflammatory lesions, Crohn's disease

Fig. 7.24. TURB complication. Extraperitoneal perforation of the bladder wall due to N. obturatorius reflex. Note fat shines through

Surgical Anatomy of the Prostate Sphincter Complex

Lutz Trojan, Maurice-Stephan Michel

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Introduction

The prostate sphincter complex – usually referred to as the external sphincter – is an important landmark in endourological diagnostics and surgery. It is of utmost importance for the preservation of continence after endourological surgery. TUR-P and urethrotomy are the most common endourological procedures where the external sphincter and its anatomy have to be considered and preserved.

The knowledge on the anatomy of the external sphincter has increased over the years. The image of a plane muscular layer distal to the prostate, as often described in textbooks on pelvic anatomy, is not correct (Fig. 8.1).

Anatomy

The prostate sphincter complex consists of different muscular aspects:

- The striated sphincter itself, which is the relevant part of the complex in endourological surgery.
  - It has an omega-like shape (Ω) with the »open side« pointing towards the rectum (illustrated in Fig. 8.2b). The striated sphincter is a broad muscular loop on its ventral parts with an extension over the ventral aspects of the prostate [1, 2] (Figs. 8.2a, c, 8.3).
  - Heterogenous prostate shapes [2] (e.g. donut vs. croissant shape) result in diffe-

Fig. 8.1. Incorrect image of the external sphincter. The sphincter is often described as a muscular disc distal to the prostate.

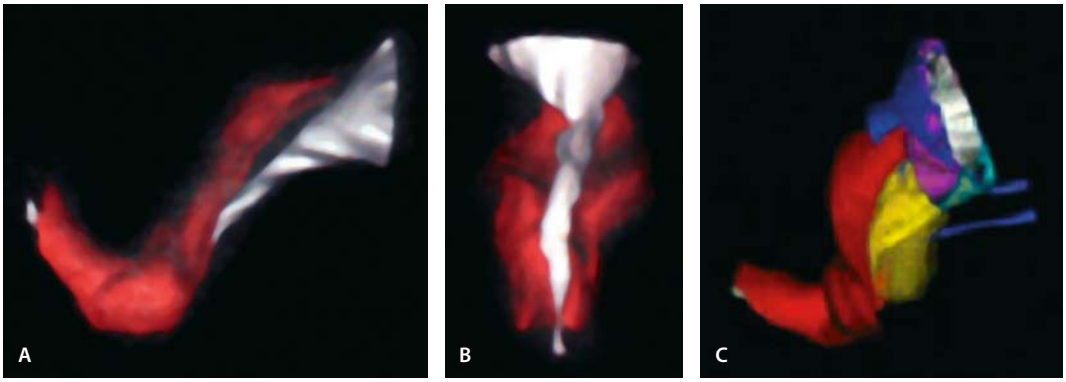

Fig. 8.2A–C. Illustration of the male striated urethral sphincter (reconstruction of the embryological situation). The sphincter extends over the ventral aspects of the prostate (**A, C**, left lateral view) and has an omega-like shape (**B**, dorsal view). *Red*: sphincter, *white*: bladder neck and urethra, *yellow*: prostate. From [1]

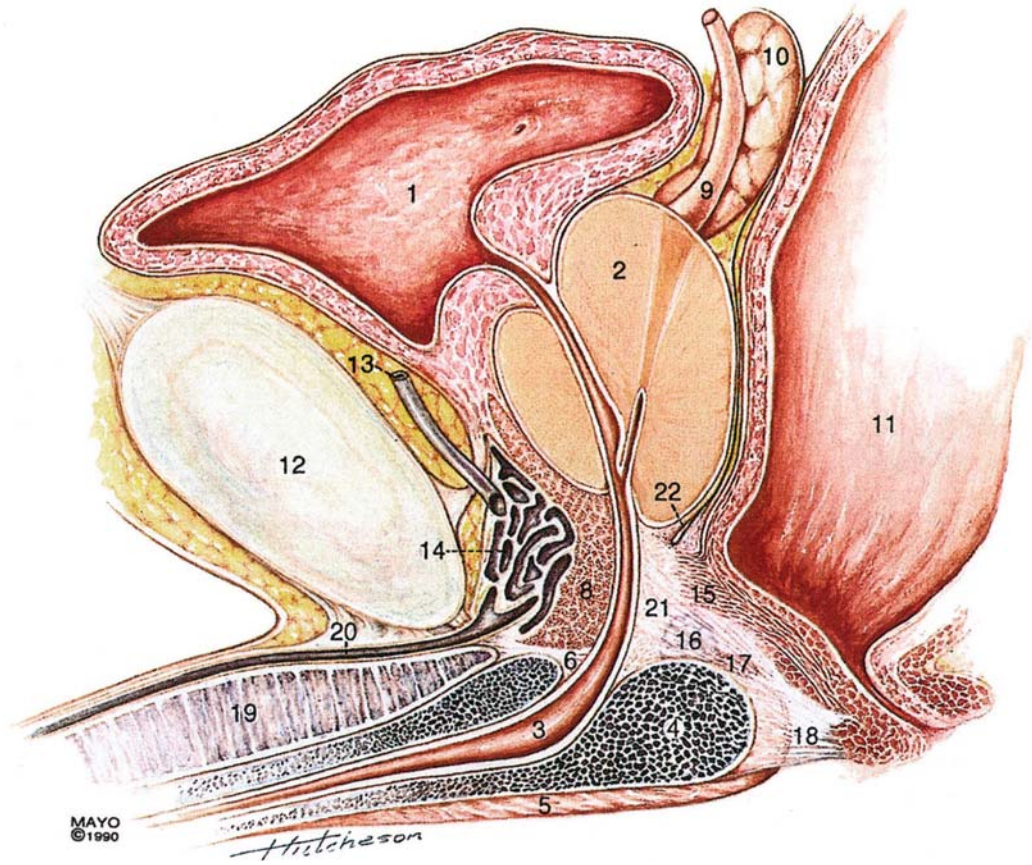

Fig. 8.3. Illustration of the male striated urethral sphincter (*sagittal view*). The sphincter (*8*) extends on the ventral aspects of the prostate. Note that in the sagittal view no sphincter but a midline fibrous raphe (*21*) is present in the dorsal aspects of the periurethral region distally from the apex of the prostate (*2*). From [4] (by permission of Mayo Foundation for Medical Education and Research. All rights reserved)

rent sphincter anatomies (Fig. 8.4). One has to keep this in mind, for example, when doing the resection of ventral apical aspects during TUR-P.

- The pubourethral aspects of the sphincter muscle.
- The urethral smooth muscles (circular and longitudinal muscular fibres).

Innervation

The innervation of the prostate sphincter complex has different origins:

- Pudendal nerve: somatic
- Branches of the sacral plexus: somatic
- Cavernous nerves (derived from hypogastric nerve and pelvic splanchnic nerve), autonomic: innervation of the urethral smooth muscles suspected.

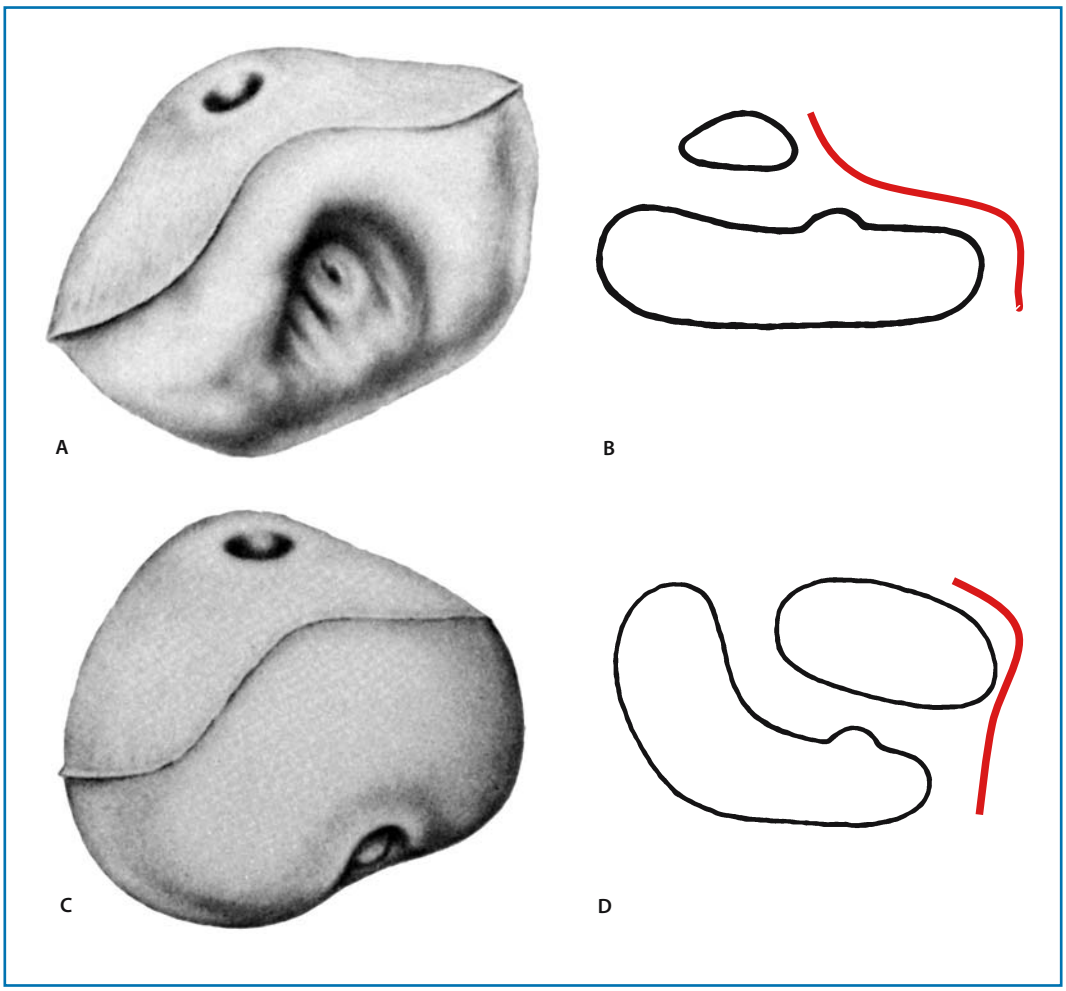

Fig. 8.4A–D. Different prostate shapes and the consecutive heterogeneous relation of the apex and the external sphincter. The shape of the prostate can occur as a crescent (**A**) or a donut (**C**). In the sagittal view (**B, D**) the relation of the prostate (*black*) and the sphincter area (*red*) with different prostate shapes is illustrated. **A, C** from [4]; **B, D** from [5] (by permission of Mayo Foundation for Medical Education and Research. All rights reserved)

Identification

- The sphincter should be identified and evaluated in every cystoscopy and surgical procedure.
- The external sphincter should be identified and evaluated at the beginning of the diagnostic or surgical procedure: initially the sphincter and its relation to the prostate is not compromised by multiple passages and/or constant placement of an instrument. Even the first passage of a shaft results in a detonization of the external sphincter.
- The prostate sphincter complex can be identified by the endourological view.
- During the procedure, the easiest method is a pull-back manoeuvre of the instrument from the prostatic urethra: the external sphincter is seen as a mucosal bulge narrowing the lumen of the urethra.
- In case of i.v. sedation of the patient, active activation of the sphincter by the patient can help to identify the sphincter: ask the patient to simulate the interruption of micturition.
- Nesbit sign, a pullback manoeuvre of the instrument from the prostatic urethra into the membranous urethra with a consecutive gentle push-forward towards the prostate facilitates identification of the proximal edge of the external sphincter by radial mucosal crinkles which are located between the distal end of prostate and the proximal edge of the external sphincter.

Injury of the Prostate Sphincter Complex

- Injury of the prostate sphincter complex results in incontinence.
- Injury of the external sphincter can occur as a result of cutting but also can be caused by coagulation lesions (development of heat in the region of the apex).
- Injury of the dorsal aspects are not as severe as a damage of the ventral or lateral parts of the sphincter due to the omega-shape of the sphincter.
- One has to differentiate between stress incontinence and a postoperative urge incontinence. The latter is not due to and= injury of the sphincter complex, mostly transient, and can be treated by a anticholinergic therapy. A urinary tract infection, which can cause urge incontinence, should be ruled out.
- Reports on the rate of incontinence vary around 0.4% [3].
- Pelvic floor training can improve the continence situation.
- Medical treatment of stress incontinence after injury of the prostate sphincter complex is usually insufficient. New drugs such as duloxetine (serotonin reuptake inhibitor, initially used as antidepressants) are currently under investigation to treat stress incontinence.
- Injection of microspheres (dextranomer/hyaluronic acid copolymer) and artificial sphincter implantation are the secondary, operative options.

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Transurethral Resection of the Prostate

Jens-Uwe Stolzenburg, Kossen M.T. Ho, Thilo Schwalenberg

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Introduction

Transurethral resection of the prostate (TURP) is a commonly performed surgical treatment for benign prostatic hyperplasia. Although in recent years technical innovation on several nonablative treatment options has become available, TURP remains the gold standard to date.

Worldwide comparison of different techniques has shown that ablative treatment produces the best outcome. Although the nonablative treatment options have the advantage of minimally invasive surgery, very often patients develop complications (such as urinary retention) that require further intervention.

TURP with currently available equipment remains a safe procedure and has a high success rate. However, it is important to learn this procedure with a strict routine in order to avoid complications and to handle difficult cases such as a large adenoma.

Preoperative Preparation

- Stop aspirin 1 week before operation.
- Rule out and treat any urinary tract infection by urine culture and sensitivity.
- Thrombosis prophylaxis should be started the evening before operation (low-molecular-weight heparin).
- Rectal enema is used the day before the operation.
- Intravenous single dose antibiotics are started at induction.

Anaesthesia

Spinal anaesthesia (for the cooperative patient, maintain intraopertaive communication with patient and provide postoperative analgesia) or general anaesthesia.

Strong Indications for Surgery (according to the EAU-Guidelines)

- Refractory urinary retention.
- Recurrent urinary retention.
- Recurrent haematuria refractory to medical treatment with 5-alpha reductase inhibitors.
- Bladder stones.
- Renal insufficiency.

Relative Indications

- Morphological changes in bladder or upper urinary tract secondary to bladder outlet obstruction, such as bladder diverticulum and hydronephrosis.
- Constant and increasing postvoid residue greater than 100 ml.
- Recurrent urinary infection secondary to bladder outlet obstruction.
- Urodynamic findings and prostatic size alone are not absolute indications for surgery. The final decision also depends on the patient's willingness for surgery.

Limitations and Risks

- Size of adenoma: greater than 50 ml not for beginners, greater than 100 ml only for advanced endoscopic surgeons; the alternative is open adenomectomy.

Contraindications

- Absolute contraindications are active urinary tract infection and uncorrected coagulopathy.
- Relative contraindications: large bladder stone (two-stage procedure–cystolitholapaxy and TURP–recommended), anaesthetic contraindications, acute renal insufficiency secondary to bladder outlet obstruction.

Instruments

- Resectoscope 24-Fr single-flow or 27-Fr/24-Fr continuous-flow rotatable resectoscope (Olympus OES Pro standard resectoscope) with 12° or 0° optics.
- Video camera with rotatable camera head (Olympus Visera).
- HF resection electrodes: band electrode (preferred), thin loop (optional for precision cuts) and roller electrode (coagulation).
- 100-ml bladder syringe.
- 20-Fr irrigation catheter.
- Optional suprapubic catheter (12-Fr) for continuous irrigation during resection.
- Lubricant.
- Electrolyte-free and sterile irrigation fluid, positioned at a height of 50–60 cm above the pubic symphysis.

Operative Technique (Step by Step)

- Lithotomy position.
- Either introduce the sheath of the cystoscope blindly with a trocar or under direct vision (urethroscopy).
- Perform urethrocystoscopy, identify the anatomical landmarks: the verumontanum (seminal colliculus), the prostatic urethra, the bladder neck and the ureteric orifices.
- If prolonged resection is anticipated (adenoma >100 ml), insert a suprapubic catheter to create a low-pressure continuous-flow circuit during resection.
- Check the position of the ureteric orifice before beginning resection at the 6 o'clock position. Resect a trench from the bladder neck to the verumontanum for orientation.
- Cutting technique: hold the sheath with the nondominant hand and fix it with the little and ring fingers onto the pubic area, so that the tip of the sheath lies at the level of the verumontanum so as to stop the loop resecting distally from the verumontanum.
- Enlarge the trench from 5 to 7 o'clock, to the circular muscle fibres of the bladder neck (internal sphincter) and the fibres of the prostatic capsule are visible. Beware: undermining of the bladder neck can happen with overzealous resection.
- With a prominent median lobe, start resecting the median lobe first.
- Beware: start resection of the median lobe from the surface and not the base. Otherwise a big median lobe remnant will fall into the bladder and it will be difficult to retrieve.
- Resection of the left lobe: starting from the established trench, the direction of resection is from 5 to 2 o'clock. At any point, deepen the resection from the adenoma surface down to the capsule.
- Refrain from resecting the bladder neck and apical region at this stage.
- Resection of the right lobe: the same technique as the left lobe, except starting from 7 to 10 o'clock.
- During resection of the lateral lobe, a tilting movement of the sheath should accompany the outward movement of the loop, because the prostate is apple-shaped rather than a cylinder.
- Resection of ventral tissue: position the sheath at the level of the verumontanum, then rotate the sheath 180° to start from 10 to 2 o'clock.
- Beware: secure the sheath at the level of the verumontanum by fixing it with a nondominant hand onto the pubic symphysis. Distal migration of the sheath may cause inadvertent resection and damage to the urethral sphincter.
- Apical resection: for a small piece of residual tissue, grasp it between the loop and the end of the sheath before resecting it by activating the current through the loop.
- Resection at the posterior bladder neck: identify the ureteric orifices first, then resect any residual obstructing tissue to create a smooth

transition from the bladder to the prostatic cavity.
- Finally, ensure hemostasis, in particular venous bleeding, by using the roller ball and stopping the irrigation fluid temporarily.
- Introduce a 20-Fr three-way catheter, inflate the balloon with 30 ml water. Apply slight traction on the catheter so that the balloon is positioned at the bladder outlet (to occlude the prostatic cavity) by tying a gauze swab on the catheter right at the tip of the penis, and then start irrigation.

Operative Tips

- With a band electrode, an electro-vaporization effect can be achieved with improved coagulation and concurrent cutting. (Tip: to produce an optimal vaporization effect, apply slow movement of this resection loop.)
- Do not resect in several places, as bleeding will obscure the view and it becomes difficult to control.
- Check completeness of resection with an empty bladder.
- Large adenomas:
  - To create a long resection trench, one can move both the loop and the sheath in a craniocaudal direction during resection. (Beware: sheath movement may make orientation more difficult during resection).
  - Follow exactly the same resection technique as described above. At any time, sufficient haemostasis should be achieved after complete resection of one lobe. This enables stopping the procedure if necessary when complications occur.
  - Differential resection: quick resection over the surface of the adenoma is possible without adequate coagulation; however, as the capsule is being approached, slower resection with adequate haemostasis is necessary.
  - Two-stage resection: if necessary a second resection can be performed 2–3 days after the first procedure. (A second intervention is not a sign of shame but a sign of wisdom).
- Capsular bleeding can be aggravated by excessive coagulation which causes capsular rupture. Instead, coagulation should avoid the vascular lumen but aim at the area around the blood vessels.
- Check the patient's blood pressure with the anaesthetist near the end of the procedure, as hypotension can obscure any bleeding point.
- To control persistent bleeding from the prostatic capsule, position and inflate a catheter balloon in the prostatic cavity. Inflate the balloon to 10 ml in the bladder first and then pull it into the prostatic cavity before further inflation of the balloon. A safer and better way is to place the catheter and balloon in the prostatic cavity under radiographic monitoring (or digital rectal control). No catheter traction should be applied in these cases.
- It is important to safeguard the catheter while the patient is transferred off the operating table, as inadvertent traction of the catheter can cause bleeding.
- Fixation of the resectoscope by the nondominant hand of the operator.
- The tip of the sheath of the resectoscope is fixed at the level of the verumontanum by maintaining a constant position with the middle and ring finger at the region of the symphysis pubis. In this position, one is able to rotate the resectoscope without any longitudinal shift in position. An injury to the external sphincter causing incontinence is thereby avoided.
- The correct fixation of the resectoscope is especially important to the beginner during resection of the lateral lobes and the ventral part of the adenoma. During these steps of the procedure, the verumontanum is not visible. Repeated visualization of the verumontanum

during the procedure is recommended to ensure a safe anatomical reference point.

Postoperative Care

- When the irrigation fluid becomes clear, catheter traction can be released up to 4 h.
- Continue irrigation of the bladder overnight.
- If there is no complication, the catheter can be removed 2 days after operation.

Common Complications

- Bleeding: Watch out for macroscopic haematuria in the recovery area, endoscopic re-interventions may be necessary. Bleeding requiring transfusion occurs in 3.9% of patients [3].
- Undermining of the bladder neck: if the defect is large, stop the procedure after haemostasis, insert a guidewire into the bladder through the sheath, remove the sheath and then slide a catheter over the guidewire into the bladder. Leave the catheter in for 5 days before further intervention.
- Inadvertent peritoneal puncture during suprapubic catheter insertion may cause intraperitoneal fluid leakage during TUR with continuous irrigation. Stop resection, insert a 10-mm laparoscopic port midway between the umbilicus and the anterior superior iliac spine, insert a drain through the port before port removal.
- Capsular perforation with entry into the periprostatic venous plexus may lead to TUR syndrome.

TUR Syndrome

Intravascular absorption of a large volume of irrigating fluid without electrolytes during transurethral resection of the prostate can cause a so-called TUR syndrome.

- Pathophysiology: hypo-osmolar, electrolyte-free, hypotonic hyperhydration (hypervolaemic, hypo-osmolar, hyponatraemia, acidosis). First of all, nonspecific clinical symptoms (frequent yawning, agitation, feeling cold, periphery cyanosis), sudden development of hyper- or hypotension with bradycardia, then quick development of circulatory disturbance, hyponatriaemic shock with kidney failure, brain and lung oedema possible.
- Treatment: patient should be managed in the intensive care unit, given 100% oxygen, replace sodium only if serum sodium is below 120 mmol/l and at a rate of not more than 10 mmol/h (very slow infusion with 200 ml hypertonic 3% normal saline). Give Lasix in every case and in certain cases also give mannitol. To improve left ventricular function, give nitrate and dobutamine.
- Prophylactic measures: limit the hydrostatic pressure of the irrigating fluid to 50–60 cm water, limit the operating time of resection (60 min of resection time) and close patient monitoring, optimized by regional anaesthesia.
- 2% volume ethanol can be added to the irrigation fluid routinely. With the concurrent measurement of expiratory alcohol concentration with an alcometer, real-time monitoring of the absorption of irrigation fluid (Widmark-formula) can be measured and then TUR syndrome can be avoided [1, 2].

Postoperative Complications

- Haematuria (beware: recurrent bleeding is possible weeks after operation).
- Clot retention (3.3% [3]) leading to a blocked irrigation catheter. Beware: the clot may lead to short-circuiting of the irrigation fluid and can give a false impression of clear effluent.
- Urinary tract infection (documented by culture) 2.3% [3] including epididymitis.

Late Complications

- Urethral stricture 3.8% [4]. With 24-Fr resectoscope, incidence is less than 2%. It is unnecessary to do a preliminary Otis urethrotomy before TURP.
- Bladder neck stenosis 4% [4] (treatment: endoscopic incision at 5, 7 and 12 o'clock position).
- Stress incontinence 2.2% [4].
- Sexual dysfunction (retrograde ejaculation 65%–70% [4] and erectile dysfunction 6% [4]).

New Developments

Transurethral resection in saline. A new class of resectoscopes combined with special high-frequency generators makes resection in saline possible. In contrast to conventional TUR, the new resectoscopes integrate both electrodes within the instrument, making the earth plate unnecessary. Since the high-frequency current is delivered via the resection loop to the sheath of the resectoscope, there is no uncontrolled flow of current through the patient's body. Due to the use of saline as irrigation medium, the risk of TUR syndrome is reduced significantly.

Acknowledgements. The authors gratefully acknowledge the assistance of Mr. Jens Mondry (Director, Moonsoft, Germany) for preparing Figs. 9.1–9.7.

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Image Gallery

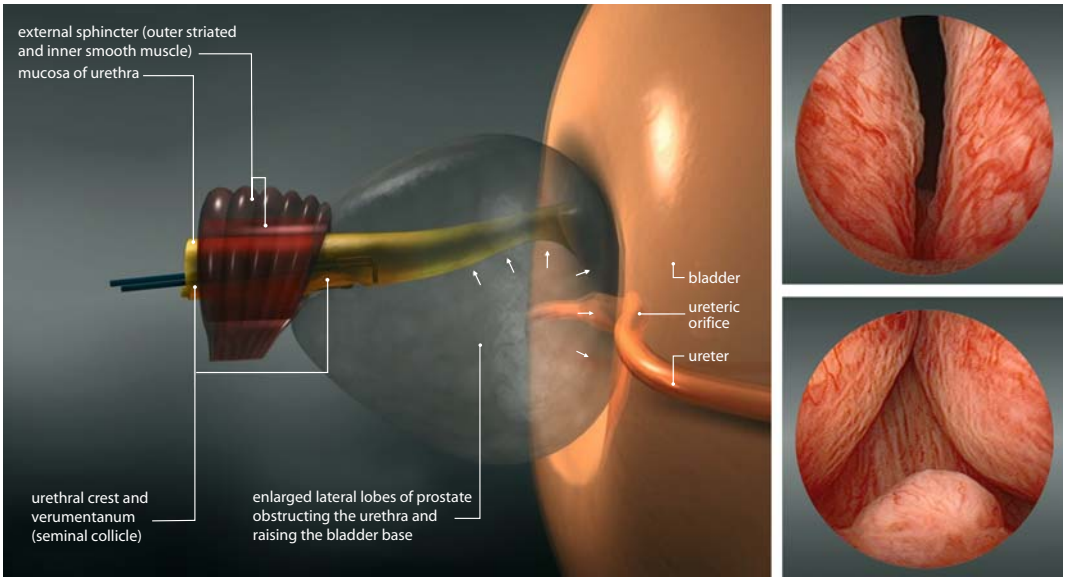
external sphincter (outer striated and inner smooth muscle)
mucosa of urethra
bladder
ureteric orifice
ureter
urethral crest and verumentanum (seminal collicle)
enlarged lateral lobes of prostate obstructing the urethra and raising the bladder base

Fig. 9.1. 3D diagram of anatomical landmarks for TURP. Endoscopic views of lateral lobe adenoma at the bladder neck (*right top*) and lateral lobe adenoma at the level of the verumontanum (*right bottom*)

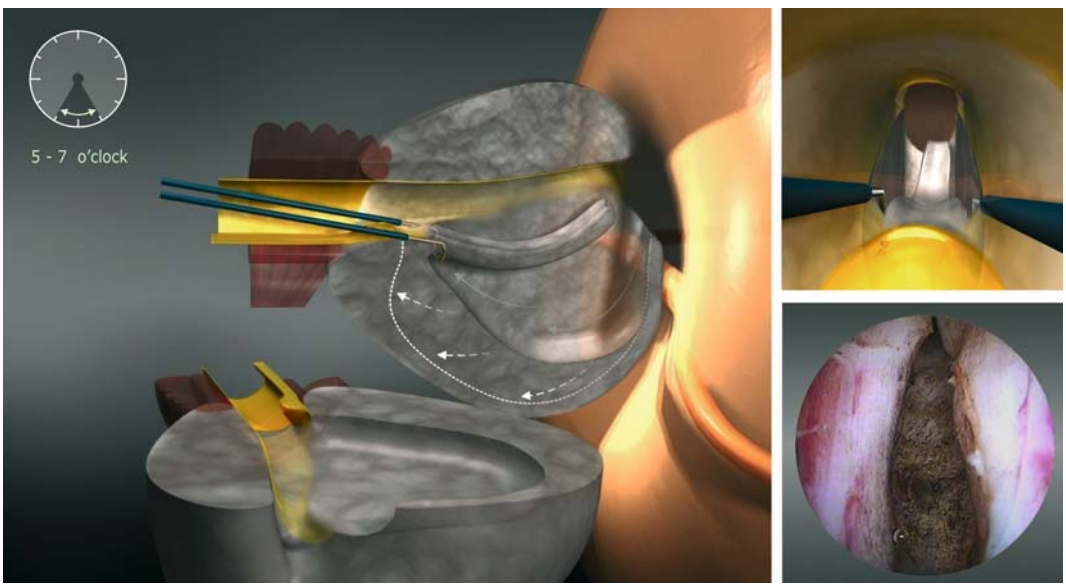

Fig. 9.2. Step 1: Trench resection from the bladder neck to the verumontanum starting at 6 o'clock position

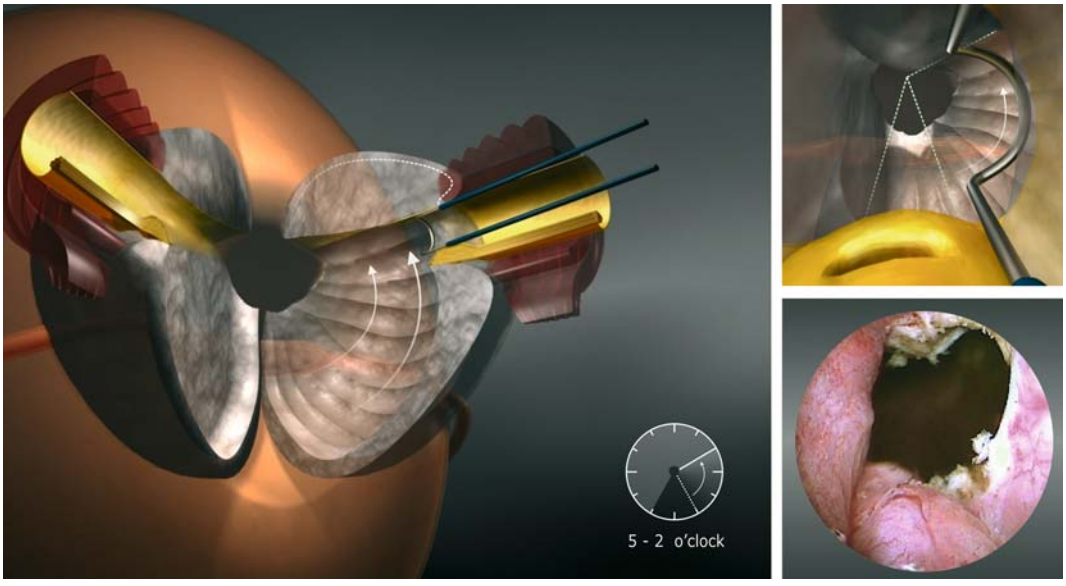

Fig. 9.3. Step 2: Resection of the left lobe

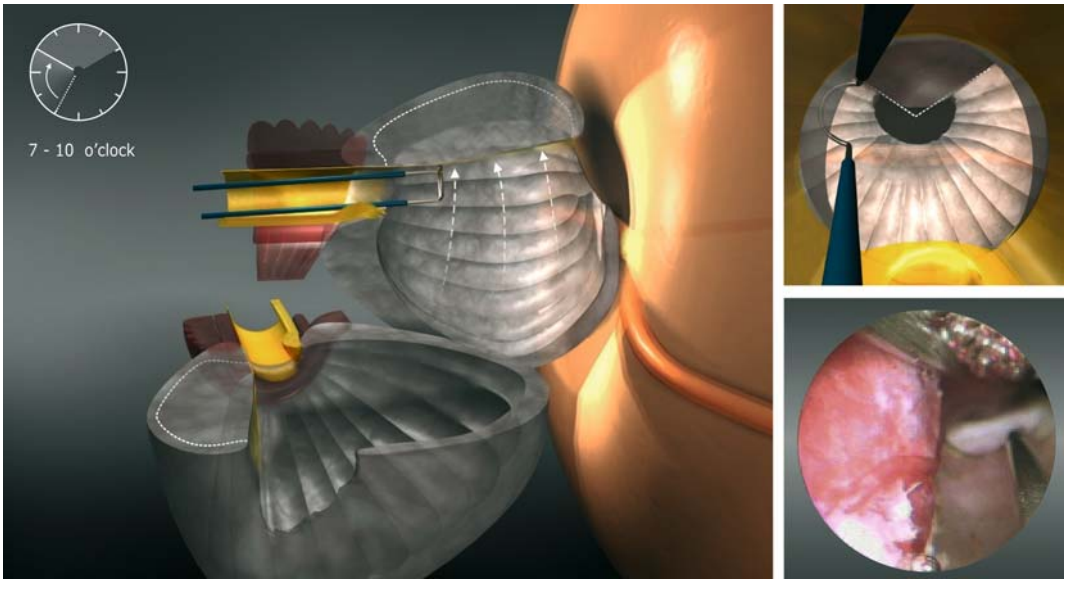

Fig. 9.4. Step 3: Resection of the right lobe

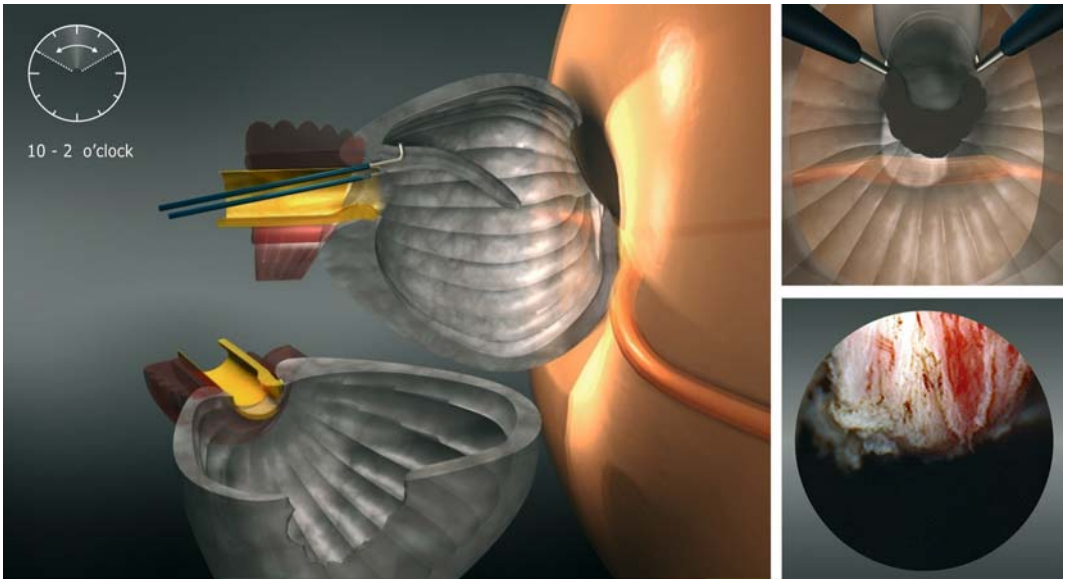

Fig. 9.5. Step 4: Resection of the ventral part of the adenoma

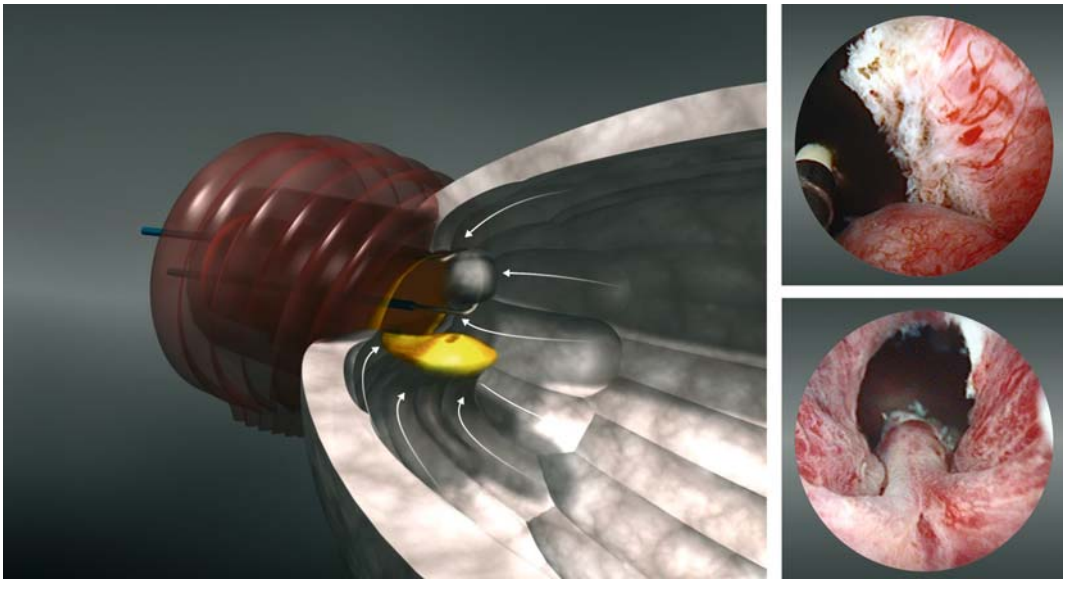

Fig. 9.6. Step 5: Apical resection. Resection of the left apical tissue, with the verumontanum at 6 o'clock position (*right top*). Complete clearance of apical tissue, viewed from the urethral sphincter (*right bottom*)

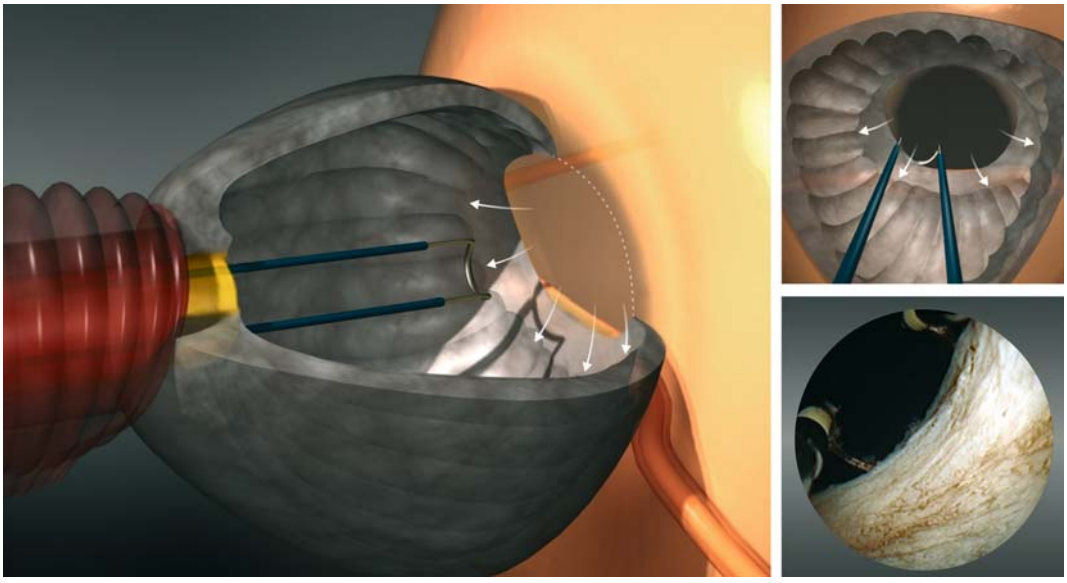

Fig. 9.7. Step 6: Resection of residual tissue at posterior bladder neck. *Right bottom*: Resection of obstructing circular fibres of the internal sphincter at the bladder neck

Fig. 9.8. Cystograms following TURP. Normally, catheter balloon positioned at bladder outlet occluding the prostatic cavity (*left*). Catheter balloon positioned within the prostatic cavity in cases where tamponade is required (*middle*). Insufficient tamponade from catheter balloon in prostatic cavity (*right*)

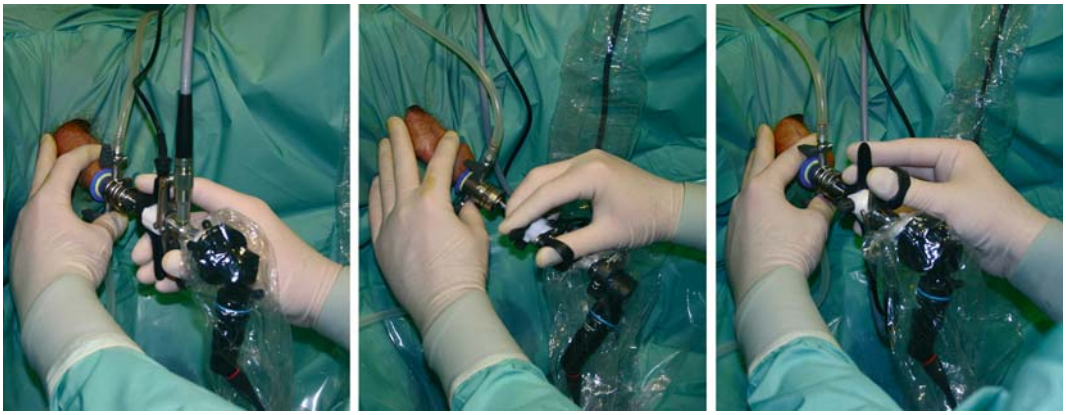

Fig. 9.9. Fixation of the sheath of the resectoscope with the nondominant hand at the symphysis pubis region, so that the tip of the sheath lies at the level of the verumontanum: Resection from 5–7 o'clock (*left*), resection of the left lateral lobe (*middle*), resection of the ventral part of the adenoma from 10–2 o'clock (*right*).

Minimal Invasive Transurethral Resection of the Prostate

Jan Fichtner

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Introduction

While standard transurethral resection of the prostate (TUR-P) remains the gold standard for surgical treatment of BPH in selected patients with significant comorbidity and subsequently elevated operative risk factors, the questions of a minimal invasive alternative to standard TUR-P may arise.

For this indication a variety of primarily non-ablative treatment options (laser, thermo, cryo, TUNA, etc.) have been described with limited results and significant associated costs.

A minimal TUR-P (MINT) with the aim of creating a prostatic channel with resection of limited tissue during a short intervention (10 min) is described in a modification of the original Nesbit technique. The resection is limited to the anterior tissue from the 11 o'clock to the 1 o'clock position without involvement of the lateral and median lobes. This resection technique, in contrast to the one described by Flocks, allows creation of a channel sufficient for bladder emptying and avoids protruding lateral lobes. Apart from the short operative duration, the risk of bleeding with this technique is very low.

Anesthesia

Spinal anaesthesia.

Indications

- Recurrent urinary retention.
- Recurrent urinary tract infection secondary to bladder outlet obstruction.
- In patients with high anesthesiologic risk (ASA III–IV).

Contraindications

- Uncorrected coagulopathy.
- Associated bladder stones.
- Acute renal insufficiency.

Instruments

- A 24-Fr resectoscope with 0° optic.
- Video camera with rotatable camera head
- A 20-Fr irrigation catheter.
- Lubricant.
- Optional trocar cystostomy for low pressure resection.

Operative Technique (Step by Step)

- Lithotomy position.
- Blind trocar or visual insertion of the resectoscope sheath.
- Urethrocystoscopy with identification of verumontanum, prostatic urethra, bladder neck and ureteral orifices.
- Fixation of the sheath at the level of the verumontanum with the left hand and rotation of the loop to the 12 o'clock position.
- Eversion of the loop and beginning of the resection at the bladder neck and 12 o'clock.
- Immediate hemostasis with the back-gliding loop over the exposed tissue.
- Creation of a tunnel by additional resection at the 11 and 1 o'clock position.
- Optional bladder neck incision at the end of the procedure.

Operative Tricks

- Resection with slowly gliding loop achieves an optimal coagulation effect
- The surgeon's left hand is of importance for securing the sheath at the verumontanum and avoidance of sphincter damage.

Postoperative Care

- Irrigation for 12–24 h.
- Catheter removal with clear irrigation after 24 h.
- Removal of suprapubic tube with residual urine below 50 cc.

Image Gallery

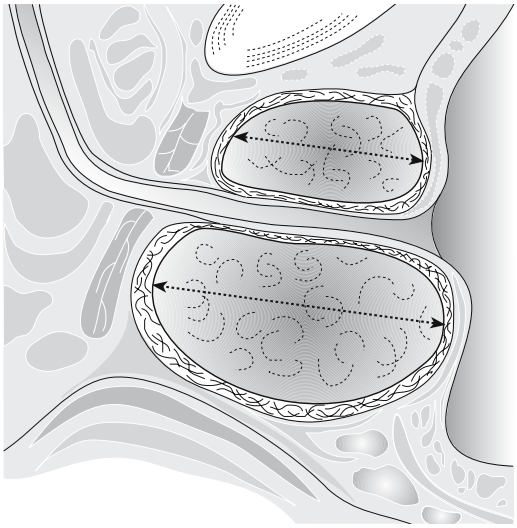

Fig. 10.1. Small amount of anterior tissue

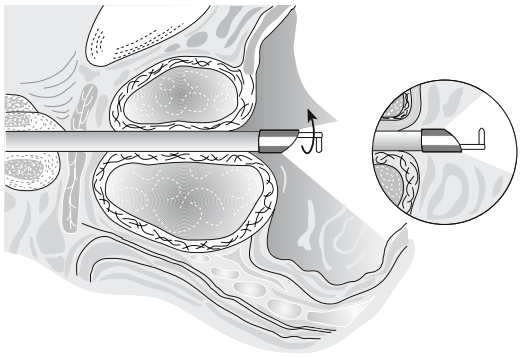

Fig. 10.2. Rotation of the loop to the 12 o'clock position

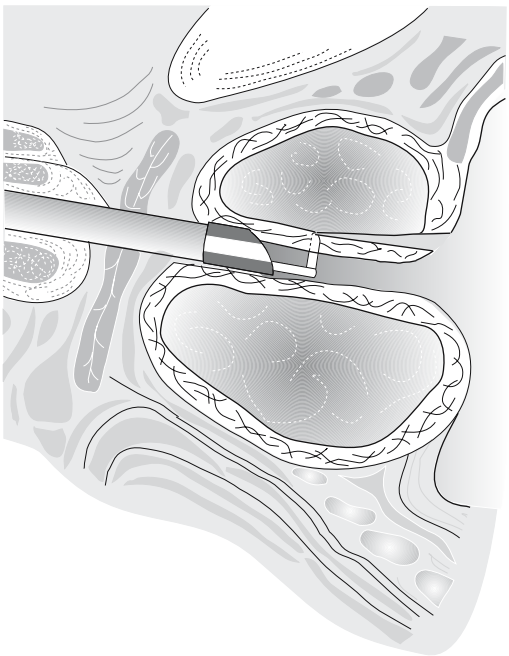

Fig. 10.3. First resection at the 12 o'clock position

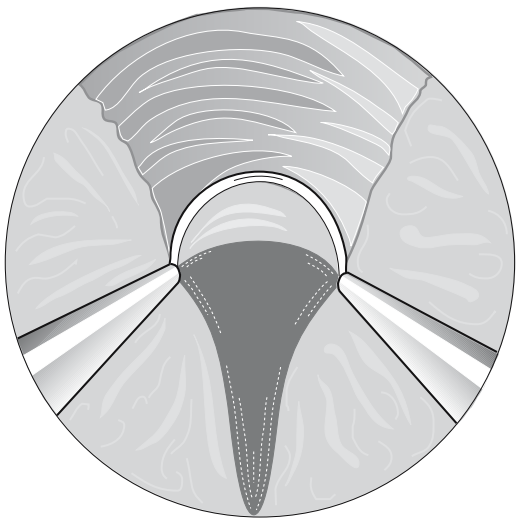

Fig. 10.4. Resulting anterior channel

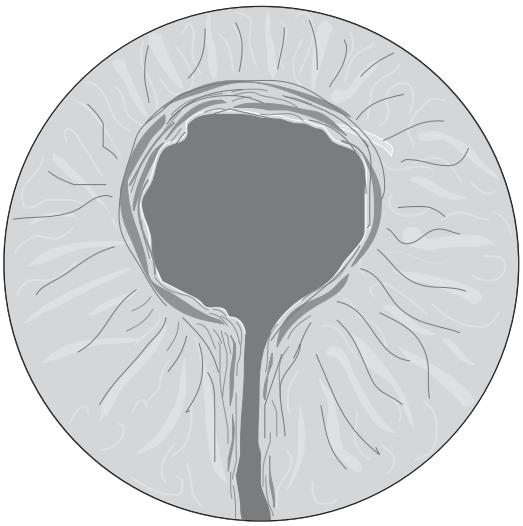

Fig. 10.5. Completion of the voiding channel following resection from 11 to 1 o'clock

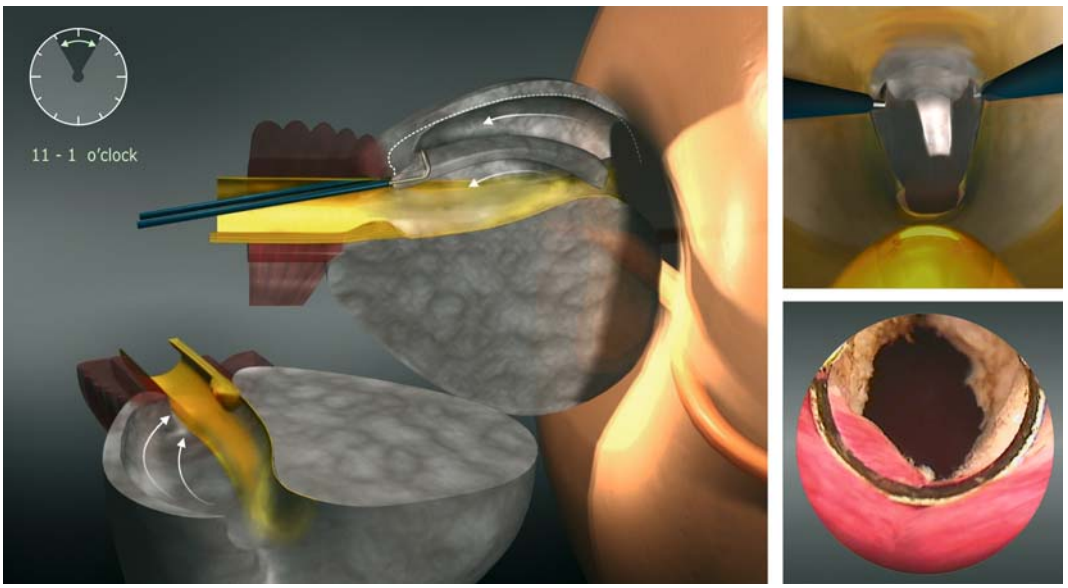

Fig. 10.6. Minimal invasive transurethral resection of the prostate: Channel formation from 11–1 o'clock position (*left and right top*). Final endoscopic view (*right bottom*)

Percutaneous Nephrolithotomy and Percutaneous Nephrostomy

Jens-Uwe Stolzenburg, Chris Anderson, Evangelos N. Liatsikos, Thilo Schwalenberg

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Introduction

The advent of new technologies has paved the way for the refinement of endoscopic techniques for the treatment of pelvocalyceal stones. Percutaneous nephrolithotomy (PCNL) is a safe and minimally invasive approach when compared to open surgery for patients with pelvo-calyceal stones. During the past decade, the indications for PCNL have been better defined, and there is a unanimous trend towards minimally invasive procedures for the treatment of such calculi.

Mastering of percutaneous techniques is deemed necessary for the safe and effective management of stone disease. Stones varying in size, from small pelvic stones to complete staghorn calculi, can be treated successfully with PCNL [1–4]. The main goal in the management of patients with stone disease, from the perspective of patient satisfaction, is how much stone burden is left behind and at what cost. Therefore the patient should be well informed about the alternative treatment regimes and should be offered the optimal therapeutic treatment.

Preoperative Preparation

- Confirm sterile urine, antibiotic prophylaxis perioperatively.
- If pyuria treat with antibiotics 24–48 h preoperatively.
- If positive culture is identified treat with antibiotic according to culture sensitivity for a minimum of 5 days.

Anaesthesia

General anaesthesia or epidural anaesthesia for cooperative patient.

Indications

- Stones within the pelvocalyceal system are not suitable, due to their size, for extracorporeal shock wave lithotripsy (ESWL).
- ESWL failures.
- Stones with concurrent ureteropelvic junction obstruction.
- Stones within calyceal diverticuli.
- Anatomic abnormalities (i.e. horseshoe kidney).

Contraindications

- Absolute contraindications are active urinary tract infection and non controlled coagulopathy.
- Relative: prior transperitoneal renal surgery may cause retrorenal projection of the bowel (CT scan evaluation is imperative).

Instruments

- Nephroscopes vary in size from 19 to 24 Fr (Olympus).
- 0.038-inch J-tip guidewire.
- Conventional endoscopic tower.
- Access dilators (different types):
  - Concentric metal serial dilators (nondisposable).
  - Amplatz dilators.
  - Balloon dilator.
- Lithotripsy unit:
  - Ultrasonic probe. Probes vary in size according to the nephroscopes.
  - Holmium laser.
- Endoscopic graspers (size according to the nephroscope's working channel).
- Electrolyte-free and sterile irrigation fluid, positioned at a height of 50–70 cm above the kidney.
- Nephrostomy tube.
  - Council catheter.

- Malecot catheter with or without ureteral tail.
- Pigtail nephrostomy tube for mini PCNL.

Operative Technique (Step by Step)

Part I: Retrograde Placement of the Ureteral Catheter

- Occlusion of the renal pelvicalyceal system (PCS) creates artificial hydronephrosis congestion to facilitate puncture and prevents dislocation of stone fragments into the ureter during the procedure.
- The patient is placed in the lithotomy position. A ureteral balloon tipped catheter (5–7 Fr) is placed retrogradely by cystourethroscopy. Retrograde pyelography is performed to confirm correct placement of balloon catheter and location of stone. Fill the balloon with sterile water and apply slight traction (under X-ray guidance) in order to ensure that it fits snugly in the pelviureteric junction (PUJ).
- If any problem is encountered in placing this balloon catheter a standard 7-Fr ureteral catheter without balloon can be used and is placed in the renal pelvis (placement is easier but there is a higher risk of stone dislodgment). Distension of the PCS in this case is created with irrigation fluid alone.
- A Foley catheter is inserted and the ureteral catheter is attached (taped or ligated) to it. The catheter is connected to a urine bag and the ureteral catheter is attached to irrigation fluid (height: approximately 1 m above the patient). Irrigation is started.
- Filling is performed to create hydronephrosis to facilitate puncture (tip: if failure to distend PCS fill with fluid from a syringe).

Part II: Percutaneous Access

- Patient is placed in the prone position with padded support underneath the abdomen, chest and elbows.
- Anatomical window for puncture of the kidney: cranially, inferior costal margin of 12th rib; caudally, iliac crest; medially, paravertebral musculature; laterally, posterior axillary line (lateral abdominal wall).
- Puncture is directed either with ultrasound or radiographic guidance into the lower calyx with an 18-gauge needle. The access is completed using the Seldinger technique.
- Ultrasound is performed to delineate the PCS and ascertain the exact location of the upper, middle and lower calyces. The ultrasound probe has an incorporated needle-guiding facility to direct the puncture into the desired target area.
- Alternatively, radiographic guidance with the aid of a C-arm can be used to achieve access to the PCS. Retrograde pyelography via the ureteric catheter is performed to delineate the calyx. One dimensional radiographic access is extremely cumbersome and thus not recommended.
- Advantages of lower calyceal puncture:
  - Stone fragments can be removed from the lower calyx where they are most likely to collect.
  - The calyx and the infundibulum offers a favourable axis for the passage of the rigid nephroscope into the pelvis.
- Exceptions:
  - In calyceal diverticular stones: puncture directly into the diverticulum.
  - Stones in middle or upper calyx (see operative tips).
- Guidewire is placed well within the renal pelvis or even into the upper calyx if possible.
- Insert the guiding rod coaxially to the guidewire and avoid kinking of the guidewire.
- Establishment of the working tract is achieved by progressive dilatation with the aid of concentric metal serial dilators.
- Dilatation under radiographic guidance prevents perforation of renal pelvis.

- Finally, the sheath of the nephroscope is advanced into the renal pelvis. Be aware of risk of perforation since there is no resistance to the advancing nephroscope.

Part III: Management of the Stone

- The nephroscope is introduced and the collecting system is inspected.
- The initial guidewire is removed and the lithotripsy system is introduced.
- Constantly irrigate the collecting system with isotonic irrigation fluid to ensure optimal visibility.
- Ultrasonic lithotripter is recommended with advantages of continuous suction effect allowing a clear view and minimizing dislodgement of fragments.
- Alternatively, laser (smaller stones) can be used; stone fragments must be removed with a stone grasper.
- Tip: with large fragments remove the fixed stone together with the nephroscope through the sheath. Make sure that the sheath stays in place while removing fragments to avoid loss of working tract and/or dislocation of the stone into the working tract.
- Avoid excessive leverage of the rigid nephroscope to prevent rupture of the collecting system or haemorrhage.
- Once lithotripsy is completed, the guidewire is reinserted into the renal pelvis. The collecting system is thoroughly inspected for stone fragments. This particularly must include inspection of the UPJ and the junction of the working tract and lower calyx. The guidewire ensures safe reinsertion of the sheath and nephroscope if continuity with the calyx is lost.
- Place the nephroscope in the lower calyx and perform pyelography to exclude residual stone fragments and inadvertent rupture of the PCS.
- The nephroscope is removed and a 20-Fr balloon nephrostomy is placed via guidewire into the renal pelvis. Under X-ray guidance, the balloon is filled (2 ml) and placed into the renal pelvis or upper calyx. Secure the nephrostomy with a ligature at skin level.
- Rotate the patient to the supine position and remove the ureteral catheter. Leave the Foley catheter to identify haemorrhage postoperatively.

Operative Tips

- In individual cases, a large calculus or staghorn might fill the entire lower calyx, making it impossible to distend the collecting system by irrigation; therefore puncture is made directly onto the stone. The rigid end of the guidewire is placed directly onto the stone. The dilatation of the working tract is performed with constant direct contact with the stone (advanced technique).
- Staghorn calculi might fill the entire collecting system, requiring more than one puncture. This might be necessary through the middle or upper calyx during the same procedure.
- In diverticular stones, puncture is made directly into the diverticulum with the help of a mini-nephroscope.
- If there are remnant stones of smaller diameter in areas inaccessible to the rigid nephroscope, insert a flexible cystoscope (or ureterorenoscope) through the nephroscope sheath. Stone fragmentation or removal can be achieved by laser, Dormia basket and/or graspers. Further inaccessible fragments can be managed electively by ESWL.
- If significant rupture of renal pelvis occurs place nephrostomy and leave ureteral catheter in situ.
- Some operators recommend insertion of a stiff 0.038-inch guidewire through the initially positioned open-end 6-Fr ureteral catheter. When percutaneous access is completed, the upper end of the guidewire is

retracted through the sheath, ascertaining a through-and-through (percutaneous access site–transurethral site) secure access for any further manipulations. A 27- to 30-Fr access sheath is required [1–4].

Postoperative Care

- Postoperative antibiotic prophylaxis when required (infected stones).
- Transurethral catheter is removed 6–24 h after the initial procedure when urine is clear.
- Nephrostomy is kept in place 3 days. Antegrade nephro-uretero-tomography is performed prior to removal to ascertain stone clearance.

Common Complications

- Intraoperative haemorrhage:
  - Minor: if irrigation alone allows adequate visualization continue the procedure.
  - Major: abandon procedure after insertion of nephrostomy. Clamping the nephrostomy (10–60 min) assists in tamponading the bleeding. A large-diameter nephrostomy tube is recommended. The procedure can be continued 3–4 days later.
- Early recognition with a decision to abandon the procedure and return some days later is commendable and not a sign of failure!
- Postoperative haemorrhage:
  - Minor: clamp nephrostomy for 10–20 min.
  - Major: clamp nephrostomy for 10–20 min, release the clamp; if bleeding continues clamp for up to 1 h. This manoeuvre is repeatable. If haemorrhage persists, consider selective embolization.

Rare Complications

- Pneumo- and/or hydrothorax: prompt recognition and a drainage tube is required.
- Perforation of the bowel during dilation: a drainage into the bowel is deemed necessary and open exploration should be considered.
- Major vessel injury during dilation maneuvers: urgent open conversion.
- A-V communication with presence of pseudoaneurysm requesting angiography and selective embolization.
- Renal artery stenosis due to inadvertent injury during the initial procedure.

Acknowledgements. The authors gratefully acknowledge the assistance of Mr. Jens Mondry (Director, Moonsoft, Germany) for preparing the figures.

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Image Gallery

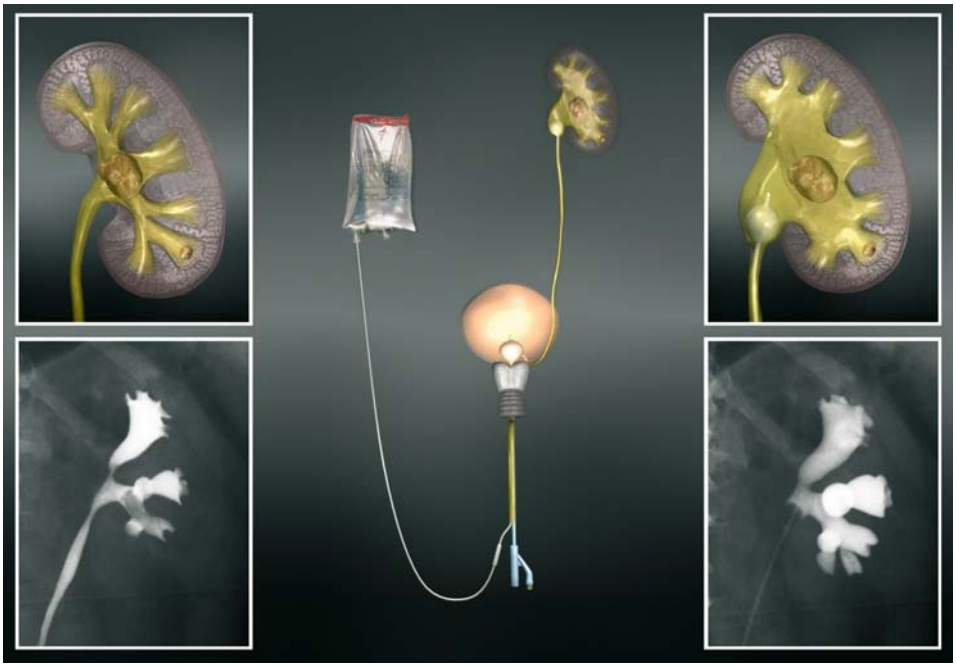

Fig. 11.1. Retrograde placement of the ureteral catheter to occlude the renal pelvi-calyceal system. *Left*, status preoperatively; *right*, artificial hydronephrosis to facilitate puncture and to prevent dislocation of stone fragments into the ureter during the procedure

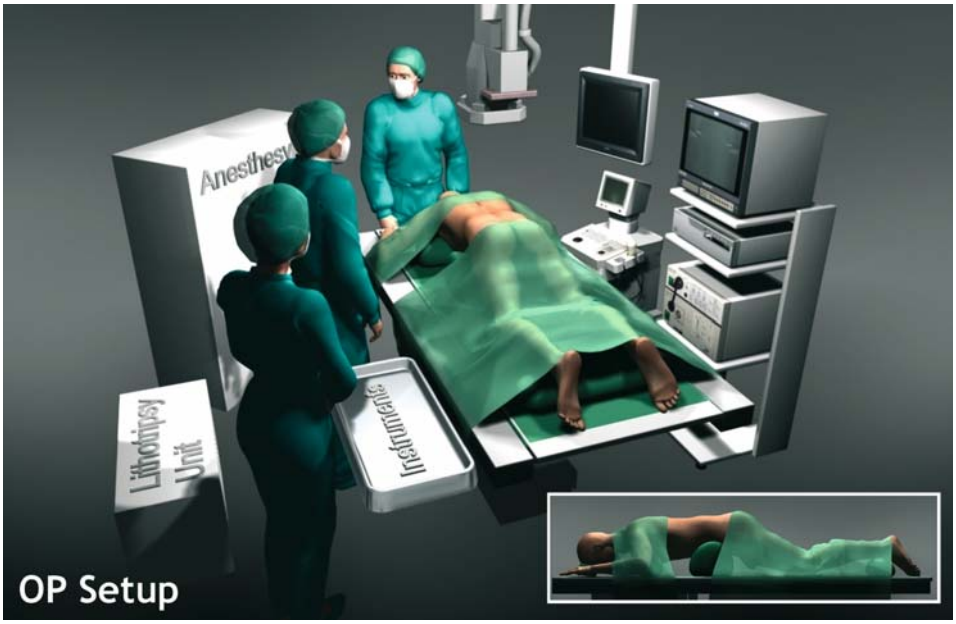

Fig. 11.2. Room set-up for PNS and PCNL

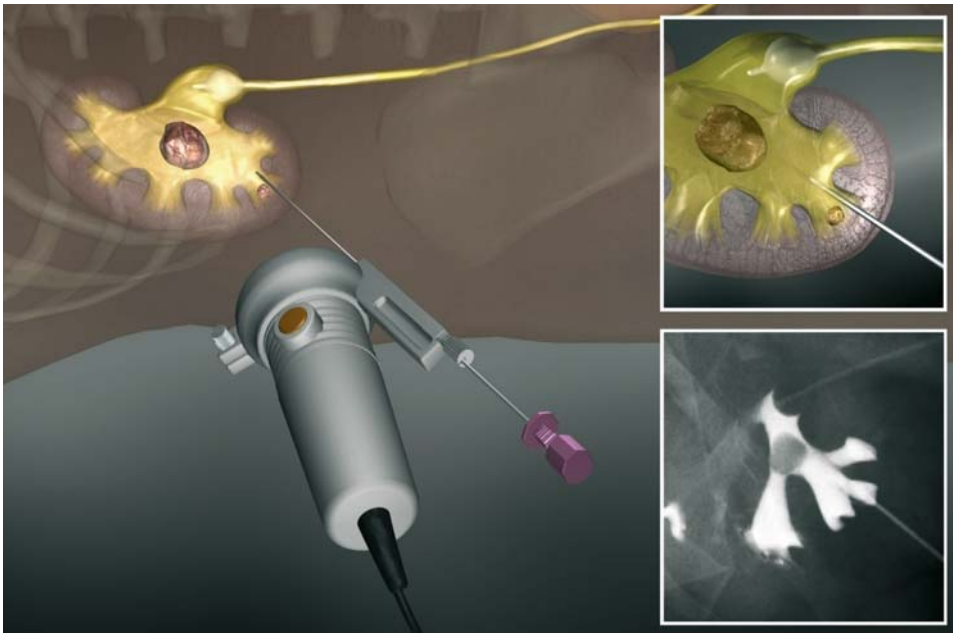

Fig. 11.3. Ultrasound-guided puncture into the lower calyx with an 18-G needle.

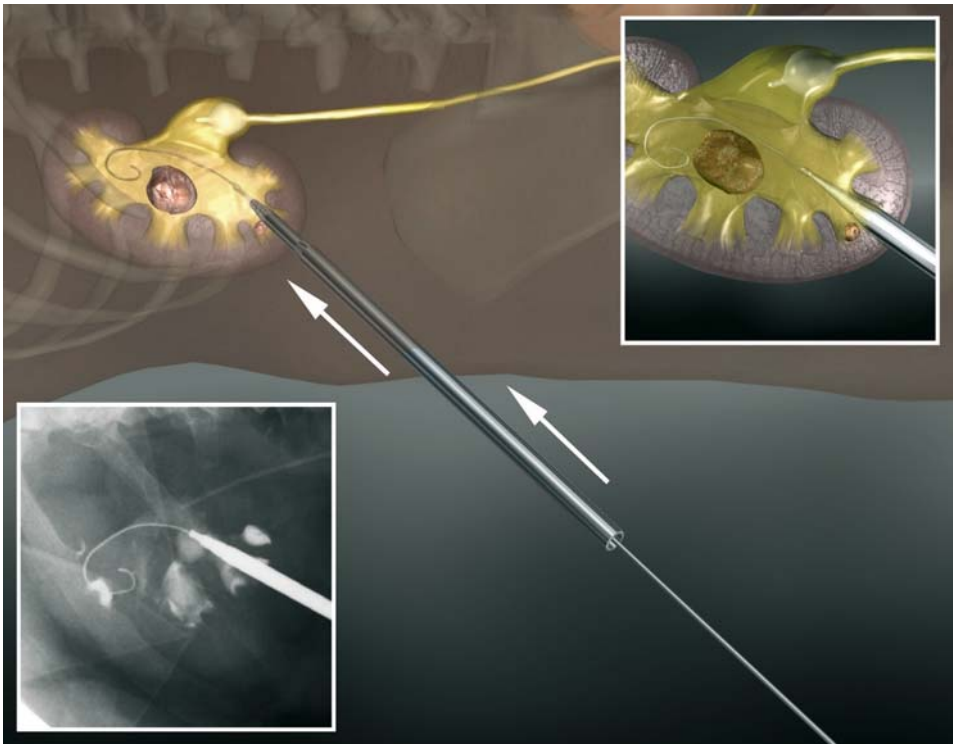

Fig. 11.4. Establishment of the working tract achieved by progressive dilatation with the aid of concentric metal serial dilators

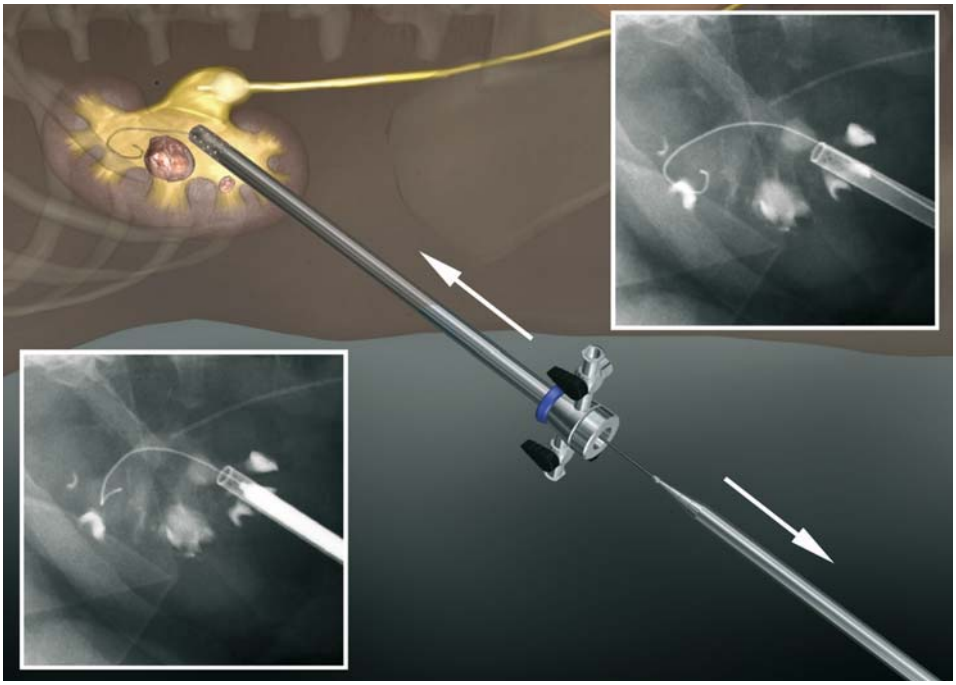

Fig. 11.5. Placement of the sheath of the nephroscope into the renal pelvis

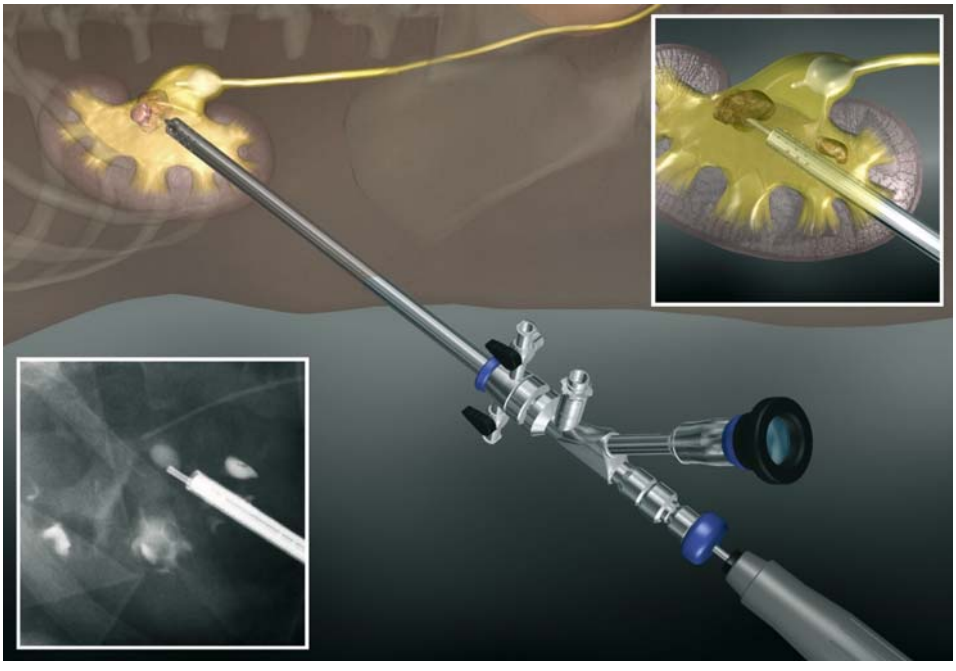

Fig. 11.6. Introduction of the nephroscope and ultrasonic lithotripsy

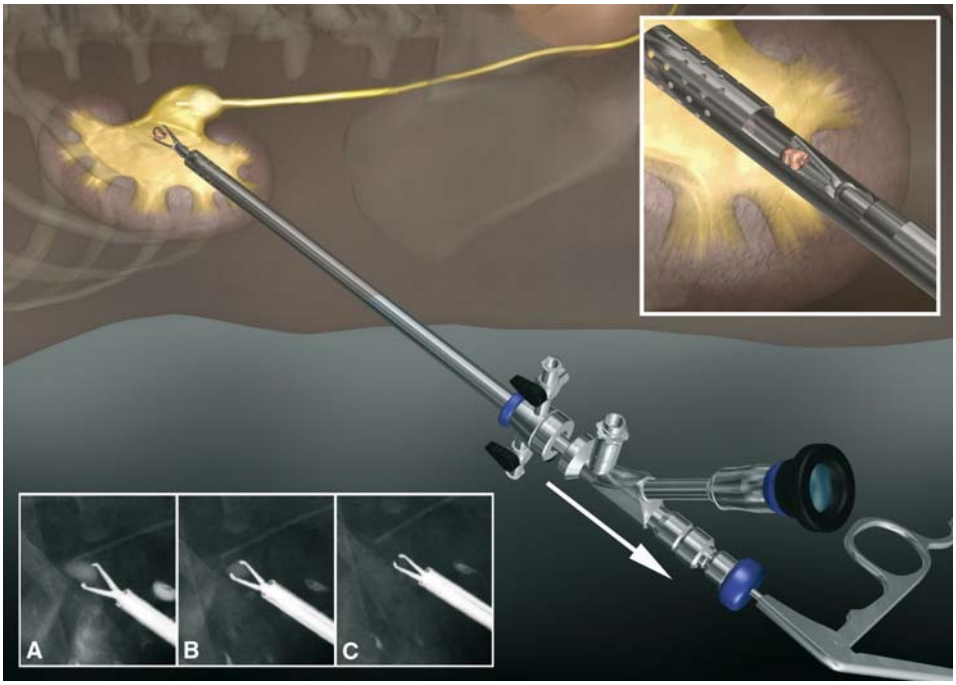

Fig. 11.7. Removal of stone fragments with a stone grasper: The fixed stone is removed together with the nephroscope through the sheath. X-rays: **A** and **B**: stone too big (danger: loss of working tract and/or dislocation of the stone into the working tract), **C**: stone removable through the sheath

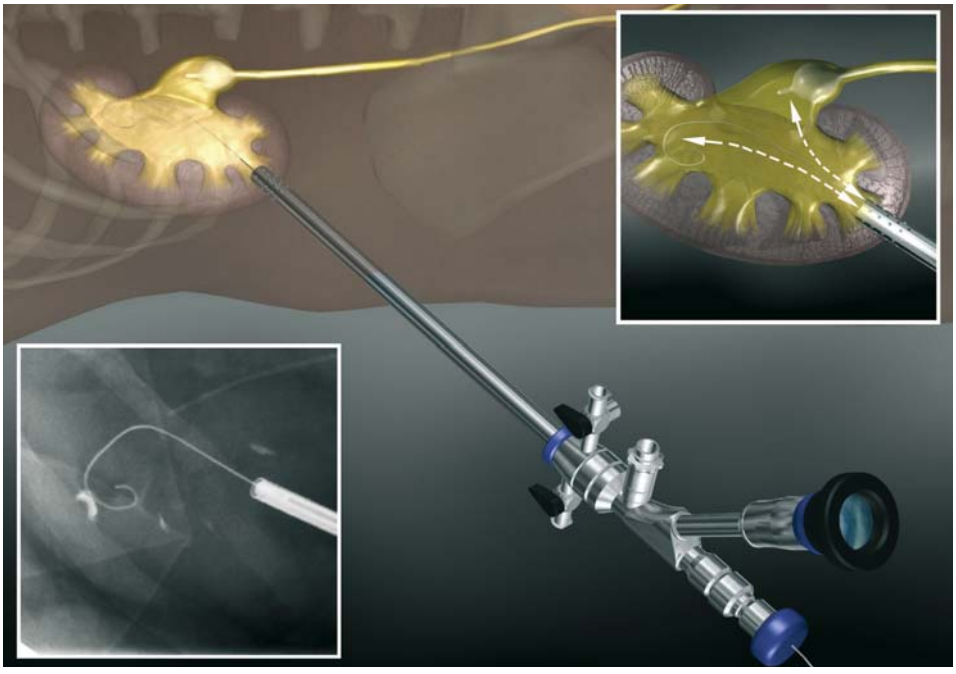

Fig. 11.8. Inspection of the collecting system for stone fragments: This must particularly include inspection of the UPJ and the junction of the working tract and lower calyx

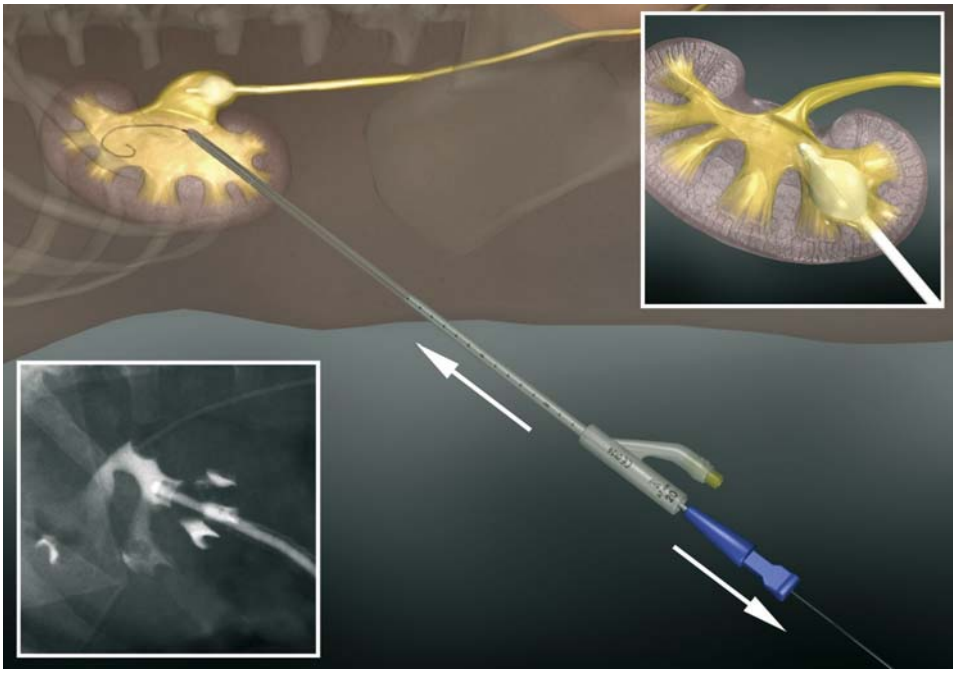

Fig. 11.9. Placement of the nephrostomy via guidewire into the renal pelvis or upper calyx at the end of the procedure

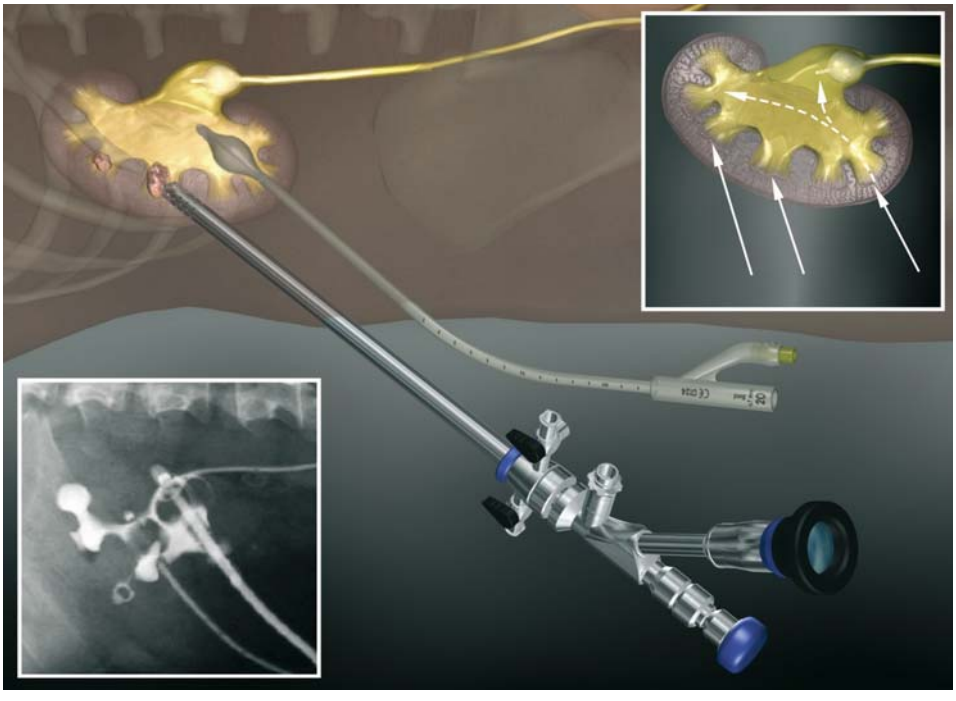

Fig. 11.10. Stone lithotripsy through the lower, the middle or upper calyx during the same procedure (Staghorn calculi)

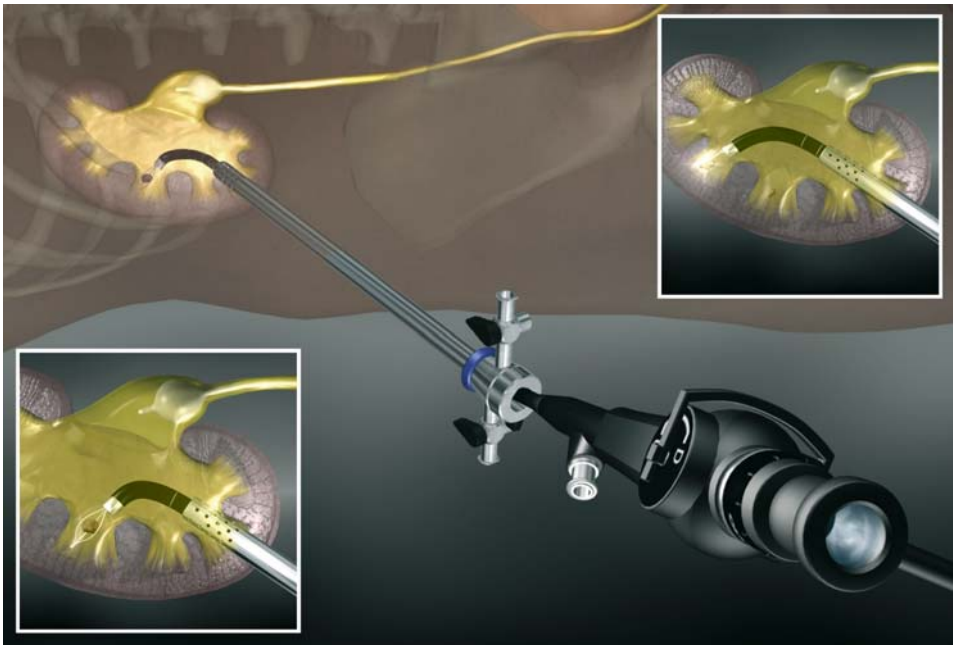

Fig. 11.11. Stone fragments of smaller diameter in areas inaccessible to the rigid nephroscope: A flexible cystoscope (or ureterorenoscope) is inserted through the nephroscope sheath. Stone fragmentation or removal can be achieved by laser or Dormia basket

Ureterorenoscopy

Thomas Knoll, Maurice-Stephan Michel

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Introduction

Although extracorporeal shockwave lithotripsy is still used for the majority of urinary stones, endourology, in particular ureterorenoscopy (URS) has become more important during the past few years. Increased experience and recent technological improvements such as active tip deflection, better lithotripsy probes and laser technology have led to a worldwide rising frequency of ureterorenoscopic procedures and an enlargement of indications [1, 2]. Today, URS offers a safe and efficient procedure not only for the treatment of upper urinary tract calculi, but also for diagnostics, treatment of strictures and tumour ablation.

This chapter will focus on retrograde stone removal, which accounts for by far the most indications for URS.

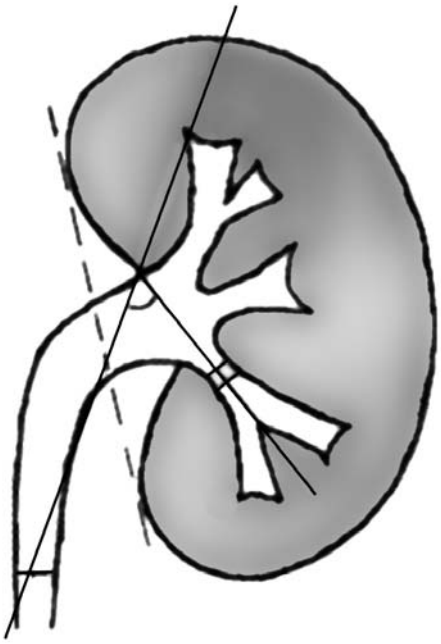

Fig. 12.1. Infundibulopelvic angle for preoperative planning of lower pole access

Preoperative Preparation

Imaging

- Plain abdominal radiography (kidney, ureter, bladder, KUB) and intravenous pyelography (IVP). Radiocontrast imaging gives important information on renal spatial anatomy, which is mandatory for optimal preoperative planning of flexible ureterorenoscopies. Estimation of the infundibulopelvic angle can give information, if the lower renal pole is accessible with the available flexible scope (Fig. 12.1).
- Retrograde pyelography is useful if intravenous contrast agent cannot be injected.
- Abdominal helical CT scan has displaced routine KUB/IVP in many centres in the United States because it offers fast diagnosis without using contrast agents. However, X-ray exposure and costs are higher than for KUB/IVP
- Ultrasound.

Patient Preparation

- Stop anticoagulants (acetylsalicylacid, cumarines/warfarin, clopidogrel) 7–10 days before.
- Any urinary tract infection (UTI) should be treated by antibiotics according to sensitivity.
- Perioperative antibiotics if there is UTI, parenchymal reflux or traumatic procedure (e.g. ciprofloxacin).
- Thrombosis prophylaxis with low-molecular-weight heparin starting the evening before operation.

Patient Positioning

- Patients are placed in lithotomy position.
- Abduction and lowering of the contralateral leg improves freedom of movement for the endourologist (Fig. 12.2).

Fig. 12.2. Ideal OP setting for ureterorenoscopy

Equipment

URS should be performed ideally with real-time fluoroscopy and video endoscopy (Fig. 12.2). Fluoroscopy during the procedure allows visualization of the ureter with contrast media and adds valuable information for a successful ureteroscopy.

Anaesthesia

- General anaesthesia or spinal anaesthesia. Spinal anaesthesia has been demonstrated to be safe and feasible for distal ureter stones, while general anesthesia should be preferred for proximal ureter and kidney stones.
- Intravenous analgesia has been shown to be sufficient for distal ureter stones in female patients [3].

Indications for Ureterorenoscopy

Ureter Stones

- Distal ureter:
  - Stone-free rates after extracorporal shockwave lithotripsy (SWL) and URS are comparable [4–6].
  - The advantages of SWL include missing invasiveness; the advantage of URS is the fast procedure for a stone-free patient after a single procedure. The decision between both options should be made together with the patient and in consideration of the available equipment.
- Mid-ureter:
  - URS is advantageous compared to SWL because bone and bowel gas may interfere with stone detection [7].
- Proximal ureter:
  - Proximal ureter stones are a classical indication for SWL treatment. However, recent

studies have demonstrated that URS and holmium laser lithotripsy is highly efficient even for this localization [7].
- URS seems to be more efficient for stones greater than 10 mm.

Kidney Stones

- In principle, pelvic stones up to 15–20 mm can be disintegrated by semirigid or flexible URS [8]. However, SWL offers excellent efficiency for stones of this size and localization and should be preferred because of lower invasiveness.
- Large kidney or staghorn stones (>20 mm) should be treated by percutaneous nephrolithotomy (PNL) [8]. Residual fragments can be treated by flexible URS [1, 9].
- Flexible URS is mainly used for caliceal stones, in most cases after unsuccessful SWL treatment [9]. As the stone-free rate of SWL is unsatisfactorily poor for the lower calyx, primary flexible URS offers an attractive procedure for this localization [10].

Limitations and Risks

Taking into account the indications given above, virtually all stones can be treated efficiently and safely with modern ureterorenoscopes and lithotripsy tools. Flexible ureterorenoscopy is technically challenging and requires regular training to maintain a high level of skill. Training on models or simulators and participation in workshops are beneficial at least for the less experienced surgeons.

Contraindications

- URS has no absolute contraindications.
- Active urinary tract infections should have been treated preoperatively [4, 8].
- Coagulopathy should have been treated if possible. If blood coagulation cannot be improved, complication rate of URS is lower than of SWL. URS should therefore be preferred if intervention is absolutely necessary.
- Relative contraindications are: anatomical situations aggravating retrograde access such as phimosis, urethral stricture, large prostate adenomas, ureterocele, ureteral strictures and also coxarthrosis or former urological surgery such as ureteral reimplantation or urinary diversion.
- Pregnancy is a relative contraindication. URS has been demonstrated as safe even during pregnancy [11].

Ureterorenoscopes

Semirigid URS

- Modern ureteroscopes with calibers of 6–10.5 Fr do not require dilation of the intramural ureter. Larger instruments should no longer be used.
- Most scopes consist of optical channel, light fibres and one combined working and irrigation channel. Scopes with separate irrigation channels allow continuous irrigation flow and therefore optimized endoscopic view. The caliber, however, is larger than of scopes with one combined channel (Figs. 12.3, 12.4).

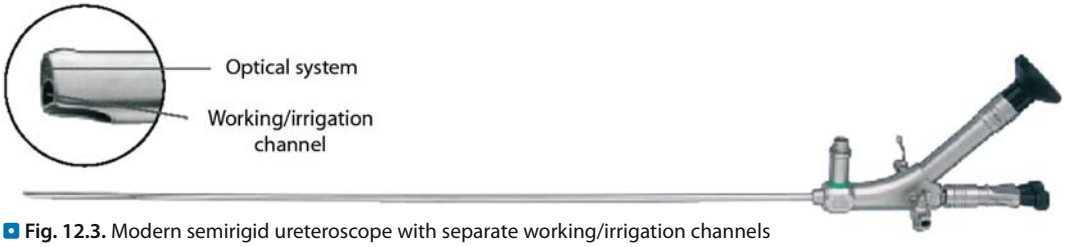

Fig. 12.3. Modern semirigid ureteroscope with separate working/irrigation channels

Flexible URS

- Flexible scopes with calibers of 6.5–9 Fr can be introduced into the upper urinary tract without prior ureter dilation.
- While flexible scopes are used proximal from the iliac vessel crossing by many urologist in the United States, we recommend the use of semirigid scopes inside the ureter whenever possible. However, for the passage of difficult anatomy such as strictures, kinking or ureter wall edema, a flexible scope may be necessary.
- Most flexible scopes have an active, bilateral deflection mechanism at the tip and a passive deflection mechanism proximally of the tip. Recently, a scope with two separate active deflection mechanisms has been introduced.
- While most standard flexible scopes have maximal deflection angles of 120°–180° (Fig. 12.5), a new generation of flexible ureterorenoscopes have bilateral deflections >270° [12] (Fig. 12.6).
- A second advantage of such new-generation endoscopes is a stiffer shaft, that improves durability and controllability

Fig. 12.4. Tip of semirigid ureteroscope with separate working/irrigation channel

Fig. 12.6. Modern generation flexible ureterorenoscope with bilateral 270° maximal tip deflection

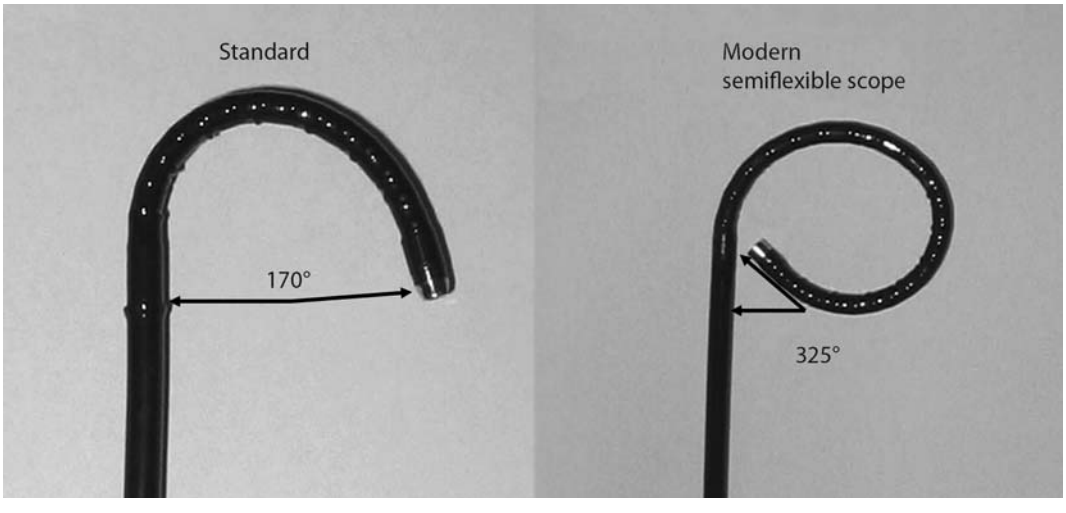

Fig. 12.5. Maximal tip deflection of standard flexible ureterorenoscope with 170° (*left*) and a modern semiflexible scope with 325° down movement (*right*)

Stone Disintegration and Stone Extraction Tools

Intracorporal Lithotripsy

Intracorporeal lithotripsy will be necessary for most fragments with sizes exceeding 3–4 mm. Several different systems are available.

Electrohydraulic

- Principle: electric current generates a flash at the tip of the probe; the resulting heat produces a cavitation bubble leading to a spheric shockwave.
- EHL is able to disintegrate stones of all chemical compositions.
- The undirected transmission of heat comes with a frequent risk of tissue injury, which is why EHL is no longer use as a standard procedure.
- Flexible electrohydraulic probes (EHL) are available in different sizes for use in semirigid or flexible scopes.

Pneumatic

- Pneumatic or ballistic lithotripsy probes with 2.4-F probes are frequently used in semirigid URS with disintegration rates over 90%.
- Safe usage and excellent cost effectiveness are advantages of these systems [13].
- The resulting mobilization of fragments into more proximal parts of the urinary tract may decrease the stone-free rate [13]. The insertion of stone baskets or special collecting tools such as the 'stone cone' can prevent this loss of fragments [13].
- Flexible probes are available but potentially impair the maximal tip deflection of the scope [10].

Ultrasound

- Principle: ultrasound-based lithotripsy probes induce high-frequency oscillation which produces ultrasound waves (23,000–27,000 Hz). The ultrasound is transmitted to the tip of the probe, leading to a vibration that disintegrates the calculi after contact.
- Combined ultrasound/pneumatic probes are available and can be used for semirigid URS and PNL [14, 15].

Laser-Based Treatment

- The neodymium:yttrium-aluminium-garnet (Nd:YAG) and the holmium:YAG (Ho:YAG) laser are mostly used for intracorporeal laser lithotripsy.
- Several fibres are available for both lasers, 365-µm fibres are typically used in semirigid, 220-µm fibres in flexible scopes [10].
- Nd:YAG: frequency-doubled lasers (FREDDY, 532 and 1064 nm) are used for lithotripsy.
  - Efficiency is low for hard stones such as calcium oxalate-monohydrate.
  - Cystine stones cannot be disintegrated with the Nd:YAG laser.
  - Low costs of the Nd:YAG laser compared to the Ho:YAG laser make this laser an interesting alternative.
- Ho:YAG: this laser type (2100 nm) can disintegrate all chemical stone compositions.
  - Currently the method of choice for stone treatment by flexible URS [16].
  - In comparison to the Nd:YAG, low tissue penetration of less than 0.5 mm produces fewer thermal injuries.
  - Less stone migration than with ballistic probes.
  - Laser probe must have contact to the stone surface.
  - Perforation of the ureter or pelvic wall is possible. An increased incidence of strictures could not be demonstrated [17].

Stone Extraction

Stone Manipulation within the Ureter

- Small fragments can be extracted directly or after prior disintegration with a forceps.

- The forceps must be pushed until the whole opening mechanism is out of the working channel to assure correct opening of the branches (Fig. 12.7).
- The advantage of a forceps is easy release of a fragment.
- The use of baskets is also possible, but has a higher risk of ureter wall damage or even sticking inside the ureter (Fig. 12.8) [2, 4, 18].

Fig. 12.7. Semirigid ureteroscope with stone forceps. *Yellow circle* marks opening mechanism which has to be out of the working channel

Fig. 12.8. Flexible ureterorenoscope with opened nitinol tipless basket

- Baskets are able to extract several small fragments at the same time. The endoscopic view is better than with a forceps because of the smaller caliber.
- Baskets (single-use) are less cost-effective than forceps (multi-use).

Stone Manipulation inside the Kidney

- Baskets made of nitinol (nickel-titanium-alloy) are suitable for use with flexible URS because of their flexibility and low risk of trauma during stone extraction. Especially the 'tipless' baskets are extremely atraumatic and ideal for use inside the kidney.
- The use of stone extraction and disintegration tools impairs maximal scope deflection in different extent. Urologists must know these factors preoperatively.

Operative Technique (Step by Step)

Cystoscopy

- Retrograde pyelography, guidewire:
  - Retrograde pyelography can be used to recognize potential anatomical difficulties.
  - Insertion of a safety wire (allows stenting even after ureter perforation).

Dilatation

- Pre-Stenting:
  - Modern thin ureteroscopes allow direct intubation of the ureteric orifice without prior dilation in most cases.
  - If primary intubation is not possible with reliable forces, stenting and later URS after 7–14 days offers a safe alternative to mechanical dilation.
  - If ureter dilation is necessary, several types such as balloons or plastic bougies are available. However, pre-stenting for 7 days before a second attempt is less traumatic and should be preferred.

Scope Introduction

- Irrigation:
  - To avoid high intrarenal pressure, the irrigation fluid should be maintained within a height of 20–40 cm H_2O above the patient.
- Ureteric access:
  - Semirigid scopes can be introduced along the safety wire. The guidewire can be used to open the orifice tent-like when the scope is passed laterally under the wire (Fig. 12.9).
  - If the ureter orifice cannot be intubated:
    - Use a second wire which is passed through the working channel.
    - Empty the bladder to reduce compression on the intramural ureter.
    - Rotate the instrument which is not round but oval.
  - Flexible scopes are inserted in most cases via a guidewire (which should have two floppy tips to avoid damage of the vulnerable working channel). The latest-generation flexible ureteroscopes have a stiffer shaft that allows direct orifice intubation for the experienced surgeon [1, 12].
  - After access to the ureter, the scope is passed slowly and carefully until the stone is reached (Fig. 12.10). Ideally, the whole ureter circumference should be visualized during the entire procedure. Because of narrow ureter parts and peristaltic, this will not be possible all the time. However, the instrument should never be pushed forward when the tissue mucosa is not moving simultaneously.
  - If the view inside the ureter is not sufficient:
    - Use more irrigation.
    - Push a second guidewire with a floppy tip through the working channel.
    - Inject contrast media through the scope to visualize the ureter anatomy.
    - If the view is poor because of bleeding and cannot be improved by irrigation: finalize the procedure and insert a DJ-stent over the safety wire.
- Access Sheaths:
  - Access sheaths of several calibers are available and can be introduced into the ureter via a guidewire.
  - Their use facilitates access to the proximal ureter and the kidney, especially in cases with large stone mass requiring multiple ureter passages [19]. However, most procedures are possible without use of such devices [20].

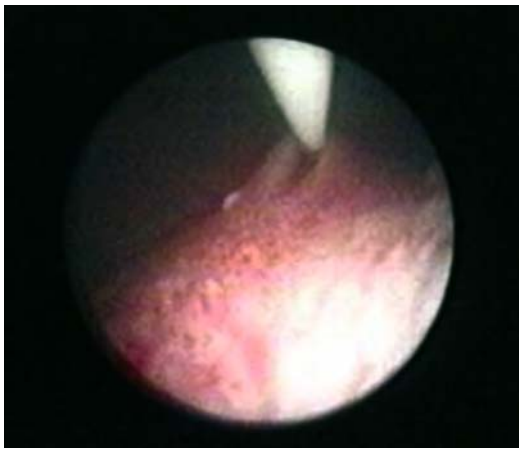

Fig. 12.9. Ureter orifice tent-like opened by guidewire

Fig. 12.10. Ureter stone with passed guidewire

- A second advantageous aspect when using access sheaths is maintaining low pressure inside the upper urinary tract and therefore reducing the risk of septicaemia.

Stone Manipulation

- Extraction
  - Small fragments are directly extracted by forceps or baskets.
- Disintegration
  - Resulting fragments after disintegration should be small but large enough for easy extraction.
  - When using a Ho:YAG laser, the result is sometimes more 'dust' than 'fragments'. Such small residuals have a high probability of spontaneous passage and can be left in the urinary tract ('smash and go'). However, patients should be followed up to ensure they reach a stone-free state.

Stenting after URS

- DJ-catheters themselves have considerable morbidity. Therefore, routine postoperative stenting should not be performed.
- Stenting after URS is necessary only in the following cases: significant residual fragments, ureter wall injury or perforation, long OR-time, ureter wall edema (stone bed) [21].
- Duration of stenting depends on particular indication, 7–14 days are sufficient in most cases.

Operative Tricks

- If the patient is placed in the Trendelenburg position (head lowered), mobilization of stone fragments into lower calices can be avoided because stone fragments will fall into upper calices, which are now the lowest point of the kidney.
- Stones within the upper calices can be reached in some cases by semirigid URS, facilitating stone manipulation.
- If direct insertion of a flexible ureteroscope is not possible, prior semirigid ureteroscopy 'optically' dilates orifice and ureter. This type of dilation is less traumatic than mechanical dilation and allows later flexible URS in most cases.
- Lower caliceal stones are often easier to disintegrate after mobilization to the renal pelvis or an upper calyx. Baskets or a nitinol grasper can be helpful for stone mobilization.
- If a calyx is not accessible with flexible URS, emptying of the renal collecting system with a syringe (use of a three-way switch on a working/irrigation channel) may facilitate the procedure.
- If a stone basket sticks inside the ureter, the handle of the basket can be removed to get the scope out of the body (according to the user's guide of the basket manufacturer). Afterwards, the ureteroscope can be inserted again beside the basket wire. If disintegration of the fragments caught inside the basket does not relieve the basket, the wires can be cut carefully by a Ho:YAG laser. However, a safety wire should have been placed before and complete removal of all residual basket wires should be assured. A less risky but more time-consuming method is the application of SWL on the basket.

Postoperative Care

- Patients after URS do not require special postoperative care, which is why the procedure is performed on an outpatient basis in many countries.
- If stents were placed, the surgeon is responsible for removal of the stent. A follow-up date should therefore be fixed when the patient is discharged.

Common Complications

- Risk of significant complications after URS is approximately 10% [4].
- Bleeding is the most common intraoperative complication and may require second-look ureteroscopy when endoscopic view deteriorates.
- Perforations of the ureter or renal pelvic wall may occur during stone disintegration or extraction, depending on the type of disintegration and the surgeon's experience. Such perforations are treated by insertion of an indwelling stent for 14 days and do not require surgical treatment.
- Ureteric avulsion remains the major complication of URS and is extremely rare (<0.5%). It usually requires open surgery.

Postoperative Complications

- Haematuria occurs frequently for 1–2 days but almost never requires active intervention.
- The incidence of urinary tract infections is between 5% and 15% and can be treated with antibiotics.
- Fever due to bacteriaemia is described in 3%–5% of all patients.
- The most common cause of postoperative fever or pain is an obstructive, non-stented ureter. Therefore, when drawing the decision between stenting or not, it should be kept in mind that the morbidity of urinary obstruction is higher than that of stenting. We still recommend stenting in any doubtful cases.
- If obstruction is the reason for postoperative fever, a DJ-stent has to be inserted as soon as possible. If retrograde stenting is not possible, a percutaneous nephrostomy (PCN) has to be undertaken.
- Ureteric strictures are long-term complications of traumatic procedures, perforations or inflammatory stone beds with an incidence less than 1%.

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